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Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION **3390**
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) **3391**

89 ASTRONOMY **3396**
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS **3397**
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION **3398**
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS **3399**
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION **3400**
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

99 GENERAL **N.A.**

Note: N.A. means that no abstracts were assigned to this category for this issue.

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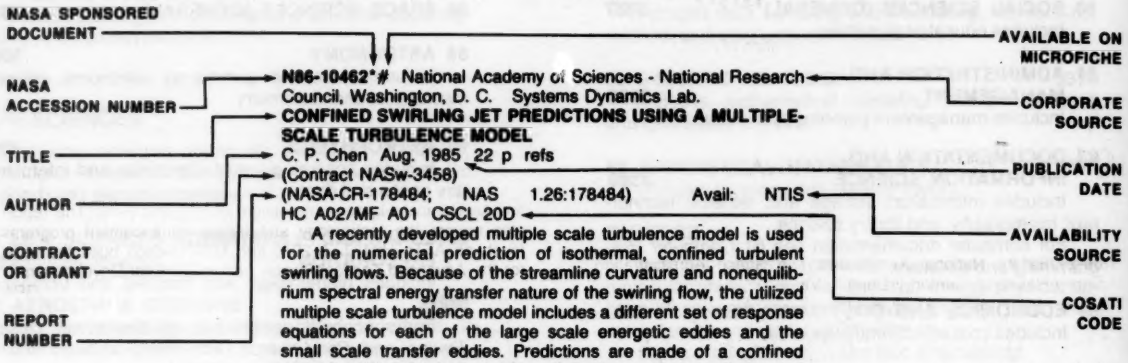
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N86-10462*# National Academy of Sciences - National Research Council, Washington, D. C. Systems Dynamics Lab.
CORPORATE SOURCE
TITLE
CONFINED SWIRLING JET PREDICTIONS USING A MULTIPLE-SCALE TURBULENCE MODEL
C. P. Chen Aug. 1985 22 p refs
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REPORT NUMBER
A recently developed multiple scale turbulence model is used for the numerical prediction of isothermal, confined turbulent swirling flows. Because of the streamline curvature and nonequilibrium spectral energy transfer nature of the swirling flow, the utilized multiple scale turbulence model includes a different set of response equations for each of the large scale energetic eddies and the small scale transfer eddies. Predictions are made of a confined coaxial swirling jet in a sudden expansion and comparisons are made with experimental data and with the conventional single scale two equation model. The multiple scale model shows significant improvement of predictions of swirling flows over the single scale k epsilon model. The sensitivity study of the effect of prescribed inlet turbulence levels on the flow fields is also included.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N86-29762*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MOTION AND INTERACTION OF DECAYING TRAILING VORTICES IN SPANWISE SHEAR WIND
Chen-Huei Liu and Ting Lu (New York Univ., New York.) Sep. 1986 26 p
(NASA-TP-2599; L-16040; NAS 1.60:2599) Avail: NTIS HC A03/MF A01 CSCL 01B

A simulation is presented of the drift of trailing vortices in a cross-wind near the ground by an unsteady, two-dimensional, rotational flow field with a concentration of large vorticity in vortical spots (having a finite but small effective size and finite total strength). The problem is analyzed by a combination of the method of matched asymptotic analyses for the decay of the vortical spots and the Euler solution for the unsteady rotational flow. Using the method of averaging, a special numerical method is developed in which the grid size and time step depend only on the length and velocity scales of the background flow and are independent of the effective core size of a vortical spot. The core size can be much smaller than the grid size, whereas the peak velocity in the core is inversely propertional to the spot size. Numerical results are presented to demonstrate the strong interaction between the trajectories of the vortical spots and the change of the vorticity distribution in the background flow field. Author

N86-29763# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTRODUCTION TO THE RECENT DEVELOPMENTS OF CHINA'S CIVIL AVIATION
11 Mar. 1986 10 p Transl. into ENGLISH from Hangkong Zhishi (China), no. 1, 1985 p 11-12
(AD-A166194; FTD-ID(RS)T-1165-85) Avail: NTIS HC A02/MF A01 CSCL 01/2

The Civil Aviation Administration of China, abbreviated CAAC, is in charge of the whole China civil aviation system. It is different from ordinary airline companies but similar to the Traffic Administration of the Japan Transportation Ministry. Its responsibility includes making policy and regulations for civil aviation, aviation traffic, operation and maintenance of civil airlines, selling of airline tickets and other commodities, management of airports, passenger lounges and anything related to civil aviation. GRA

N86-29764# Air Command and Staff Coll., Maxwell AFB, Ala.
THE SEARCH FOR AN ADVANCED FIGHTER: A HISTORY FROM THE XF-108 TO THE ADVANCED TACTICAL FIGHTER
Robert P. Lyons, Jr. Apr. 1986 101 p
(AD-A166724; ACSC-86-1575) Avail: NTIS HC A06/MF A01 CSCL 05/1

This report traces the Air Force's progress in developing advanced fighters from the XF-108 and the YF-12A for long-range supersonic interception; through the F-111 with its goal of multi-mission commonality through the F-15 air superiority fighter; then to the Lightweight Fighter Prototypes (YF-16 and YF-17) and the Air Combat Fighter competition won by the F-16. The report also covers the technology and fighter enhancement programs (such as AFTI, HiMAT, X-29A, and MSIP) which build the base for the Advanced Tactical Fighter now in Concept Development. GRA

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N86-29765*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSONIC NAVIER-STOKES WING SOLUTION USING A ZONAL APPROACH. PART 1: SOLUTION METHODOLOGY AND CODE VALIDATION
J. Flores, T. L. Holst, Unver Kaynak (Sterling Software, Palo Alto, Calif.), K. Gundy, and S. D. Thomas Apr. 1986 2 p Presented at the AGARD Symposium on Applications of Computational Fluid Dynamics in Aeronautics, Aix En Provence, France, 7-10 Apr. 1986
(NASA-TM-88248; A-86206; NAS 1.15:88248) Avail: NTIS HC A02/MF A01 CSCL 01A

A fast diagonalized Beam-Warming algorithm is coupled with a zonal approach to solve the three-dimensional Euler/Navier-Stokes equations. The computer code, called Transonic Navier-Stokes (TNS), uses a total of four zones for wing configurations (or can be extended to complete aircraft configurations by adding zones). In the inner blocks near the wing surface, the thin-layer Navier-Stokes equations are solved, while in the outer two blocks the Euler equations are solved. The diagonal algorithm yields a speedup of as much as a factor of 40 over the original algorithm/zonal method code. The TNS code, in addition, has the capability to model wind tunnel walls. Transonic viscous solutions are obtained on a 150,000-point mesh for a NACA 0012 wing. A three-order-of-magnitude drop in the L2-norm of the residual requires approximately 500 iterations, which takes about 45 min of CPU time on a Cray-XMP processor. Simulations are also conducted for a different geometrical wing called WING C. All cases show good agreement with experimental data. Author

N86-29766*# Kansas Univ. Center for Research, Inc., Lawrence.
AN INVESTIGATION OF TIP PLANFORM INFLUENCE ON THE AERODYNAMIC LOAD CHARACTERISTICS OF A SEMI-SPAN, UNSWEPT WING AND WING-TIP Final Technical Report
Johannes M. vanAken Dec. 1985 83 p
(Contract NCC2-112)
(NASA-CR-177110; NAS 1.26:177110; CRINC-5171-1) Avail: NTIS HC A05/MF A01 CSCL 01A

A semi-span wing, equipped with an interchangeable tip, which was varied in planform and size was examined. Total wing aerodynamic loading was obtained from the wind tunnel scale system. The wing tip was mounted on a separate six-component strain gauge balance, which provided the aerodynamic loads on the tip. The tests were accomplished in the NASA Ames 7 x 10 foot Wind Tunnel at a Mach number of 0.178. The aerodynamic load characteristics of the wing and of the tip were presented with the tip at several incidence angles relative to the wing inboard section. B.G.

N86-29767*# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.

CALCULATIONS OF AXISYMMETRIC VORTEX SHEET ROLL-UP USING A PANEL AND A FILAMENT MODEL

John P. Kantelis and Sheila E. Widnall Feb. 1986 182 p

(Grant NAG2-251)

(NASA-CR-177081; NAS 1.26:177081; FDRL-86-1) Avail: NTIS HC A09/MF A01 CSCL 01A

A method for calculating the self-induced motion of a vortex sheet using discrete vortex elements is presented. Vortex panels and vortex filaments are used to simulate two-dimensional and axisymmetric vortex sheet roll-up. A straight forward application using vortex elements to simulate the motion of a disk of vorticity with an elliptic circulation distribution yields unsatisfactroy results where the vortex elements move in a chaotic manner. The difficulty is assumed to be due to the inability of a finite number of discrete vortex elements to model the singularity at the sheet edge and due to large velocity calculation errors which result from uneven sheet stretching. A model of the inner portion of the spiral is introduced to eliminate the difficulty with the sheet edge singularity. The model replaces the outermost portion of the sheet with a single vortex of equivalent circulation and a number of higher order terms which account for the asymmetry of the spiral. The resulting discrete vortex model is applied to both two-dimensional and axisymmetric sheets. The two-dimensional roll-up is compared to the solution for a semi-infinite sheet with good results. Author

N86-29768*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

ANALYTICAL INVESTIGATION OF ROTOR WAKE FORMATION AND GEOMETRY Progress Report, 15 Apr. - 15 Oct. 1985

Rene Miller and Earll M. Murman 16 Jan. 1986 21 p

(Grant NAG2-275)

(NASA-CR-177032; NAS 1.26:177032) Avail: NTIS HC A02/MF A01 CSCL 01A

A number of refinements in the computer code were worked out and tested. Three codes have been written to date. One program is for an isolated wing and is being used to compare with data for the vortex wake (Weston). The second code is for an isolated wing with a streamwise vortex passing above it. This program is being used to validate the computational procedure for incorporating the vortex into the Euler equation calculations. The third program is the hovering rotor code which is the overall objective of the research. The optimization calculations for a hovering helicopter rotor have been completed. Author

N86-29769*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.

AN EXPERIMENTAL AND ANALYTICAL METHOD FOR APPROXIMATE DETERMINATION OF THE TILT ROTOR RESEARCH AIRCRAFT ROTOR/WING DOWNLOAD Final Report, 30 May 1984 - 30 Nov. 1985

David E. Jordon, William Patterson, and Doral R. Sandlin Nov. 1985 116 p

(Contract NCC2-259)

(NASA-CR-176970; NAS 1.26:176970) Avail: NTIS HC A06/MF A01 CSCL 01A

The XV-15 Tilt Rotor Research Aircraft download phenomenon was analyzed. This phenomenon is a direct result of the two rotor wakes impinging on the wing upper surface when the aircraft is in the hover configuration. For this study the analysis proceeded along tow lines. First was a method whereby results from actual hover tests of the XV-15 aircraft were combined with drag coefficient results from wind tunnel tests of a wing that was representative of the aircraft wing. Second, an analytical method was used that modeled that airflow caused gy the two rotors. Formulas were developed in such a way that acomputer program could be used to calculate the axial velocities were then used in conjunction with the aforementioned wind tunnel drag coefficinet results to produce download values. An attempt was made to validate the analytical results by modeling a model rotor system for which direct download values were determinrd.. Author

N86-29770*# Iowa State Univ. of Science and Technology, Ames. Coll. of Engineering.

VORTEX SHEET MODELING WITH HIGHER ORDER CURVED PANELS Ph.D Thesis Final Technical Report

M. Gawad Nagati 1985 115 p

(Contract NCC2-19)

(NASA-CR-176971; NAS 1.26:176971) Avail: NTIS HC A06/MF A01 CSCL 01A

A numerical technique is presented for modeling the vortex sheet with a deformable surface definition, along which a continuous vortex strength distribution in the spanwise direction is applied, so that by repeatedly modifying its shape, its true configuration is approached, in the proximity of its generating wing. Design problems requiring the inclusion of a realistic configuration of the vortex sheet are numerous. Examples discussed include: control effectiveness and stability derivatives, longitudinal stability, lateral stability, canards, propellers and helicopter rotors, and trailing vortex hazards. B.G.

N86-29771*# Oklahoma State Univ., Stillwater. School of Mechanical and Aerospace Engineering.

CORRELATION OF TRANSONIC-CONE PRESTON-TUBE DATA AND SKIN FRICTION Final Report, Nov. 1980 - May 1984

A. S. Abu-Mostafa and T. D. Reed May 1984 104 p

(Grant NAG2-76)

(NASA-CR-176902; NAS 1.26:176902) Avail: NTIS HC A06/MF A01 CSCL 01A

Preston-tube measurements obtained on the Arnold Engineering Development Center (AEDC) Transition Cone have been correlated with theoretical skin friction coefficients in transitional and turbulent flow. This has been done for the NASA Ames 11-Ft Transonic Wind Tunnel (11 TWT) and flight tests. The developed semi-empirical correlations of Preston-tube data have been used to derive a calibration procedure for the 11 TWT flow quality. This procedure has been applied to the corrected laminar data, and an effective freestream unit Reynolds number is defined by requiring a matching of the average Preston-tube pressure in flight and in the tunnel. This study finds that the operating Reynolds number is below the effective value required for a match in laminar Preston-tube data. The distribution of this effective Reynolds number with Mach number correlates well with the freestream noise level in this tunnel. Analyses of transitional and turbulent data, however, did not result in effective Reynolds numbers that can be correlated with background noise. This is a result of the fact that vorticity fluctuations present in transitional and turbulent boundary layers dominate Preston-tube pressure fluctuations and, therefore, mask the tunnel noise eff ects. So, in order to calibrate the effects of noise on transonic wind tunnel tests only laminar data should be used, preferably at flow conditions similar to those in flight tests. To calibrate the effects of transonic wind-tunnel noise on drag measurements, however, the Preston-tube data must be supplemented with direct measurements of skin friction. M.G.

N86-29772*# Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering.

[NUMERICAL COMPUTATION OF VISCOUS FLOW AROUND BODIES AND WINGS MOVING AT SUPERSONIC SPEEDS] Final Report, 15 Nov. 1971- 31 Mar. 1984

John C. Tannehill Apr. 1984 21 p

(Grant NGR-16-002-038)

(NASA-CR-176903; NAS 1.26:176903; ISU-ERI-Ames-84483; CFD-9) Avail: NTIS HC A02/MF A01 CSCL 01A

Research in aerodynamics is discussed. The development of equilibrium air curve fits; computation of hypersonic rarefield leading edge flows; computation of 2-D and 3-D blunt body laminar flows with an impinging shock; development of a two-dimensional or axisymmetric real gas blunt body code; a study of an over-relaxation procedure forthe MacCormack finite-difference scheme; computation of 2-D blunt body turbulent flows with an impinging shock; computation of supersonic viscous flow over delta wings at high angles of attack; and computation of the Space Shuttle Orbiter flowfield are discussed. Author

N86-29773*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
EXPERIMENTAL AND THEORETICAL STUDY OF PROPELLER SPINNER/SHANK INTERFERENCE M.S. Thesis
Carl Clayton Cornell May 1986 143 p
(Contract NAS3-272)
(NASA-CR-176954; NAS 1.26:176954) Avail: NTIS HC A07/MF A01 CSCL 01A

A fundamental experimental and theoretical investigation into the aerodynamic interference associated with propeller spinner and shank regions was conducted. The research program involved a theoretical assessment of solutions previously proposed, followed by a systematic experimental study to supplement the existing data base. As a result, a refined computational procedure was established for prediction of interference effects in terms of interference drag and resolved into propeller thrust and torque components. These quantities were examined with attention to engineering parameters such as two spinner finess ratios, three blade shank forms, and two/three/four/six/eight blades. Consideration of the physics of the phenomena aided in the logical deduction of two individual interference quantities (cascade effects and spinner/shank juncture interference). These interference effects were semi-empirically modeled using existing theories and placed into a compatible form with an existing propeller performance scheme which provided the basis for examples of application. Author

N86-29774*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECT OF REYNOLDS NUMBER AND MACH NUMBER ON FLOW ANGULARITY PROBE SENSITIVITY
Leigh Ann Smith and Jerry B. Adcock Sep. 1986 28 p
(NASA-TM-87750; L-16069; NAS 1.15:87750) Avail: NTIS HC A03/MF A01 CSCL 01A

Preliminary calibrations were performed on nine flow angularity probes in the Langley 7- by 10-Foot High-Speed Tunnel (7 x 10 HST) and the Langley 0.3-Meter Transonic Cryogenic Tunnel (0.3-m TCT). These probes will be used in surveying the test section flows of the National Transonic Facility (NTF). The probes used in this study have a pyramid head with five pressure orifices. The calibrations consisted of both isolated probe measurements and rake-mounted multiprobe measurements that covered a range of subsonic Mach numbers up to 0.90 and Reynolds numbers per foot up to 40 X 10 to the 6th power. The preliminary calibration in the 7 x 10 HST included testing the probes both individually and in a rake. The 0.3-m TCT calibration tested two probes singly at varying Reynolds numbers. The results from these tests include Mach number, Reynolds number, and rake-mounting effects. The results of these tests showed probe sensitivity to be slightly affected by Mach number. At Reynolds numbers per foot above 10 x 10 to the 6th power, the probe did not exhibit a Reynolds number sensitivity. Author

N86-29775*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STABILITY AND CONTROL OF COMPRESSIBLE FLOWS OVER A SURFACE WITH CONCAVE-CONVES CURVATURE Final Report
Lucio Maestrello, Alvin Bayliss, Paresh Parikh, and Eli Turkel Jul. 1986 34 p Submitted for publication
(Contracts NAS1-17070; NAS1-18107; NAS1-17919)
(NASA-CR-178143; ICASE-86-48; NAS 1.26:178143) Avail: NTIS HC A03/MF A01 CSCL 01A

The active control of spatially unstable disturbances in a laminar, two-dimensional, compressible boundary layer over a curved surface is numerically simulated. The control is effected by localized time-periodic surface heating. We consider two similar surfaces of different heights with concave-convex curvature. In one, the height is sufficiently large so that the favorable pressure gradient is sufficient to stabilize a particular disturbance. In the other case the pressure gradient induced by the curvature is destabilizing. It is shown that by using active control that the disturbance can be stabilized. The results demonstrate that the curvature induced mean pressure gradient significantly enhances the receptivity of the flow localized time-periodic surface heating and that this is a potentially viable mechanism in air. Author

N86-29776*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PSEUDO-TIME ALGORITHMS FOR THE NAVIER-STOKES EQUATIONS
R. C. Swanson and E. Turkel (Tel-Aviv Univ. (Israel).) May 1986 33 p
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178127; ICASE-86-37; NAS 1.26:178127) Avail: NTIS HC A03/MF A01 CSCL 01A

A pseudo-time method is introduced to integrate the compressible Navier-Stokes equations to a steady state. This method is a generalization of a method used by Crocco and also by Allen and Cheng. We show that for a simple heat equation that this is just a renormalization of the time. For a convection-diffusion equation the renormalization is dependent only on the viscous terms. We implement the method for the Navier-Stokes equations using a Runge-Kutta type algorithm. This permits the time step to be chosen based on the inviscid model only. We also discuss the use of residual smoothing when viscous terms are present. Author

N86-29777*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ENTROPY CORRECTION METHOD FOR UNSTEADY FULL POTENTIAL FLOWS WITH STRONG SHOCKS
Woodrow Whitlow, Jr., Mohamed M. Hafez (California Univ., Davis.), and Stanley J. Osher (California Univ., Los Angeles.) Jun. 1986 14 p
(NASA-TM-87769; NAS 1.15:87769) Avail: NTIS HC A02/MF A01 CSCL 01A

An entropy correction method for the unsteady full potential equation is presented. The unsteady potential equation is modified to account for entropy jumps across shock waves. The conservative form of the modified equation is solved in generalized coordinates using an implicit, approximate factorization method. A flux-biasing differencing method, which generates the proper amounts of artificial viscosity in supersonic regions, is used to discretize the flow equations in space. Comparisons between the present method and solutions of the Euler equations and between the present method and experimental data are presented. The comparisons show that the present method more accurately models solutions of the Euler equations and experiment than does the isentropic potential formulation. Author

N86-29778# Montana State Univ., Missoula. Supersonic Wind Tunnel Lab.
BOUNDARY LAYER STABILITY MEASUREMENTS OVER A FLAT PLATE AT MACH 3 Final Report
Anthony Demetriades Nov. 1985 203 p
(Grant AF-AFOSR-0267-80)
(AD-A166188; SWT-TR-85-1; AFOSR-86-0056TR) Avail: NTIS HC A10/MF A01 CSCL 20/4

Amplification of natural disturbances in a flat plate laminar boundary layer at edge Mach number 3 have been measured in a supersonic wind tunnel with and without turbulent sidewall boundary layers. Detailed flowfield measurements were made to define the self-similar region and the point where the velocity profile first departs from the Blasius theory. The first instability mode was detected with a minimum critical momentum Reynolds number of

190 and a maximum amplified frequency of 0.000225. Amplification rates for this mode agree with the available theoretical predictions, and its low-frequency, low-R region is not as distorted by monotonic amplification as previously thought. A second, very prominent and extensive instability was found which extends to much higher frequencies beyond F = 0.00035 and which dominates the pretransitional flow. The neutral branch location of this mode associates it with the second instability mode found in hypersonic flow and serves to clarify and present a stability diagram rational over the M = 0 to 8 range. The overall amplitude gain before the first departure is still confined to low frequencies with the first mode contributing little net gain, the combined first-second modes contributing a gain of about 3, while an additional factor of 5 to 10 is provided by a mechanism active near the leading edge and apparently consistent with Mack's forcing-stability approach. GRA

N86-29779# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF ENGINE DISCHARGING JET EFFLUX ON VEHICLE AERODYNAMIC PERFORMANCE
Dao-wei Yang 24 Feb. 1986 12 p Transl. into ENGLISH from Binggong Xuebao (China), no. 1, Feb. 1985 p 45-50
(AD-A166277; FTD-ID(RS)T-1254-85) Avail: NTIS HC A02/MF A01 CSCL 20/4

Based on the fundamental theories of gas dynamics, this paper discusses the general effects of the engine discharging jet efflux (EDJE) on the flow around a vehicle, and analyzes the effect of the high temperature EDJE on vehicle aerodynamic performance, using compressed air in a wind-tunnel test to simulate the high temperature EDJE in a real jet engine. Experimental results are cited and analyzed. GRA

N86-29780# Poseidon Research, Irvine, Calif.
PRELIMINARY RESEARCH ON POST-STALL AERODYNAMICS Annual Report
S. C. Crow and R. B. Myers Sep. 1985 79 p
(Contract F49620-84-C-0084)
(AD-A166279; TR-81; AFOSR-86-0073TR) Avail: NTIS HC A05/MF A01 CSCL 20/4

Fundamental results for two and three dimensional unsteady flows are derived. A model for vortex shedding at salient edges is advanced. A two dimensional Euler solver that implements this vortex shedding mechanism is described. Results of applying this model to impulsively started flat plates with fixed and with oscillating chord at angle of attack are presented. Implications for manipulation of the vortex wake in a post stall maneuver are discussed. Extension of the numerical methodology to three dimensions is also discussed. GRA

N86-29781# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
COMPONENT BASE FLOW ANALYSIS Final Technical Report, 19 Apr. - 30 Sep. 1983
J. L. Sims Oct. 1985 166 p
(Contract DAAH01-83-D-A013)
(AD-A166283; AD-E950821; AMSMI/RD-CR-85-10) Avail: NTIS HC A08/MF A01 CSCL 20/4

A component model computer program for the solution of power-on base pressure at supersonic speeds has been modified to (1) include the effects of the upstream boundary layers upon the free shear layers and to (2) incorporate the angular recompression criterion developed by ONERA for the wake closure condition. After the program modifications were completed, an extensive set of calculations were made for comparison with experimental data. These comparisons showed that, in general, the calculated base pressures are greater than the experimental base pressures. This lack of agreement raises questions about the applicability of a single stream recompression criterion to the solution of the two stream problem. Author (GRA)

N86-29782# Grumman Aerospace Corp., Bethpage, N.Y. Research and Development Center.
AN INVESTIGATION OF TURBULENCE MECHANISMS IN V/STOL UPWASH FLOW FIELDS Final Report, Mar. 1982 - Jun. 1985
Barry Gilbert 15 Sep. 1985 94 p
(Contract F49620-82-C-0025)
(AD-A166286; RE-707; AFOSR-86-0096TR) Avail: NTIS HC A05/MF A01 CSCL 20/4

This report presents results of an experimental investigation of the abnormally high turbulent mixing layer growth rate characteristics found in the upwash regions of V/STOL flows in ground effect. The fundamental turbulent V/STOL upwash mechanisms were investigated in increasingly more complex flow configurations. Most of this study uses the two-dimensional upwash formed by the collision of opposed two-dimensional wall jets. Initial parameters used to characterize the upwash formation were identified as the maximum wall jet velocity and wall jet half velocity width. Upwash measurements were taken in flows formed from equal wall jets with the same maximum velocities and equal wall jets with the same half widths. While mixing layer growth rates were larger than those found in a free two-dimensional jet, these values were less than those previously reported. An explanation based on non-similarity conditions in the flow is offered. Abnormally high turbulence levels reported by other investigators were not found. The increased growth rate seem to be a direct effect of the head-on collisi on process. There is an indication that in the far field the upwash growth characteristics are approaching those found in free jets which has profound implications to the turbulence modelers. GRA

N86-29783# Flow Research, Inc., Kent, Wash.
IMPROVEMENTS IN CODE TUNCOR FOR CALCULATING WALL INTERFERENCE CORRECTIONS IN THE TRANSONIC REGIME Final Report, Apr. 1983 - Dec. 1985
M. H. Rizk Mar. 1986 34 p
(Contract F40600-83-C-0003)
(AD-A166766; AEDC-TR-86-6) Avail: NTIS HC A03/MF A01 CSCL 20/4

Modifications are introduced to Code TUNCOR to allow its use in determining wall interference corrections in a wind tunnel. The modifications include conversion to cylindrical coordinates and converting the measured pressure data to a form acceptable by the code. GRA

N86-29784# Sandia National Labs., Albuquerque, N. Mex.
COMPARISONS OF CFD FLOW FIELD SOLUTIONS WITH EXPERIMENTAL DATA AT MACH 14
M. A. Walker and D. D. McBride 1986 33 p Presented at the 14th AIAA Aerodynamics Testing Conference, West Palm Beach, Fla., 5 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-004915; SAND-86-0006C; CONF-860368-1) Avail: NTIS HC A03/MF A01

Experimental data obtained in the Sandia National Laboratories Hypersonic Wind Tunnel (HWT) are compared with numerical predictions made by a Computational Fluid Dynamics (CFD) computer code. The data compared are force and moment coefficients for a slender blunted cone at Mach 14. The CFD code is a Parabolized Navier-Stokes (PNS) code. Schlieren photographs of the shock shapes are compared with predictions made by the PNS code for angles of attack up to 14 deg. Oil flow photographs are compared with the numerical prediction of the location of the cross flow separation. Overall, the numerical predictions agree with the experimental data. DOE

N86-29785# Sandia National Labs., Albuquerque, N. Mex. Parachute Systems Div.
DEVELOPMENT DROP TEST RESULTS OF THE 15-FT-DIA RIBBON PARACHUTE AND 73-FT-DIA CROSS PARACHUTE FOR THE US ARMY NATICK LABORATORY UHLCADS SYSTEM
William H. Pepper Sep. 1985 27 p
(DE85-017614; SAND-84-2183) Avail: NTIS HC A03/MF A01

An existing parachute system has been adapted for delivery

of a resupply container at high altitudes from aircraft. The parachute system consists of a 15-ft-dia ribbon parachute reefed for 10 s and a 73-ft-dia cross parachute. A solid state recorder in the 2360-lb drop test vehicle was used to obtain deceleration history with time. Twelve drop tests from the C-130 aircraft were conducted at the US Army Yuma Proving Ground, Arizona. Drop release conditions were generally 130 KCAS as 25,000 ft above sea level. Several improvements to the parachute system were tested: (1) no reefing of the 73-ft cross parachute; (2) nylon instead of Kevlar for the 15-ft ribbon parachute; and (3) a new 16-s delay pyrotechnic reefing line cutter was successfully used to stage from the 15-ft ribbon parachute to the 73-ft cross parachute. Author

N86-29786# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Struct

INFLUENCE OF THE ANGLE OF ATTACK AND FLUTTER ON THE LIFT OF A SUPERCRITICAL WING. COMPARISON BETWEEN THEORY AND EXPERIMENT Final Report [INFLUENCE DE L'INCIDENCE ET DU VRILLAGE SUR LE FLOTTEMENT D'UNE AILE SUPERCRITIQUE. COMPARAISON THEORIE-EXPERIENCE]

R. Destuynder and A. Gravelle Dec. 1985 40 p In FRENCH
(Contract STPA-84-95-015)
(ONERA-RT-24/3064-RY-044-R; ESA-86-97276) Avail: NTIS HC A03/MF A01

Variations of the critical lift velocity in transonic flow (Mach 0.8) was studied. A first method is based on a linear computation of the corrections to perform on wind tunnel steady flow pressure measurements. A second nonlinear method is based on the analysis of small perturbations which take in account the deformations and the exact profile of the model. The comparison shows that both methods are close to the experimental results. ESA

N86-29787# National Aerospace Lab., Amsterdam (Netherlands). Hoofdafdel. Stromingen.

SIMPLIFIED EXAMINATIONS OF THE AERODYNAMIC PERFORMANCES OF TIP VANE ROTORS [VEREENVOUDIGDE BESCHOUWINGEN OVER DE AERODYNAMISCHE PRESTATIES VAN TIPVAAN ROTOREN]

O. deVries and J. W. Slooff Jun. 1984 107 p In DUTCH Sponsored by National Development Program on Wind Energy (NOW II) Project Management Bureau for Energy Research
(Contract ECN-4401-3.4)
(NLR-M-AT-84-007-L; ESA-86-97401) Avail: NTIS HC A06/MF A01

Based on a limit examination for a rotor with an infinite number of blades and a constant circulation distribution over rotor blade and tip vane, an estimate method for the optimal performances of a tip vane wind turbine was developed. It reveals the positive contribution of the winglet effect; that circulation (mass flow increase) and high speed are inversely proportionate; increase of the area of rotor blades and tip vanes (the quantity of blade material) leads to a mass flow increase; and performance susceptibility to the induced tip vane resistance (e.g., by incomplete synchronization). A practical consequence might be the rejection of earlier estimated optimal performances. ESA

N86-29788# National Aerospace Lab., Amsterdam (Netherlands). Hoofdafdel. Stromingen.

ESTIMATE OF THE AERODYNAMIC PERFORMANCES OF TIP VANE ROTORS USING THE HELIX PROGRAM [SCHATTING VAN DE AERODYNAMISCHE PRESTATIES VAN TIPVAAN ROTOREN M.B.V. HET PROGRAMMA HELIX]

O. deVries and W. J. Piers Feb. 1985 62 p In DUTCH Sponsored by National Development Program on Wind Energy (NOW II) Project Management Bureau for Energy Research
(NLR-TR-85027-L; ESA-86-97402) Avail: NTIS HC A04/MF A01

The computer program Helix, based on the lifting line approach, was used in performance calculations of tip vane rotors with given load distribution. Although a considerable power increase seems possible, this is limted to low high-speed values. Application of wing profiles with a high bearing force coefficient might improve the economic perspectives of the tip vane. ESA

N86-29789# National Aerospace Lab., Amsterdam (Netherlands). Hoofdafdel. Stromingen.

AERODYNAMIC RESEARCH ON TIP VANE ROTORS, CARRIED OUT BY NLR, AND A ROUGH EVALUATION OF THE TIP VANE CONCEPT [AERODYNAMISCH ONDERZOEK T.B.V. TIPVAAN ROTOREN, UNITGEVOERD DOOR NLR, EN EEN GLOBALE EVALUATIE VAN HET TIPVAAN CONCEPT]

O. deVries and J. W. Slooff Mar. 1985 39 p In DUTCH Sponsored by National Development Program on Wind Energy (NOW II) Project Management Bureau for Energy Research
(NLR-TR-85064-L; ESA-86-97406) Avail: NTIS HC A03/MF A01

Estimates for the attainable performances of a complete tip vane rotor were derived from limit models and a rotating lifting-line model. It appears that the economic perspectives are more limited than expected. An accurate feasibility analysis, preferably to be carried out by the industry, is recommended. ESA

N86-29860# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides.

THEORY AND EXPERIMENTAL STUDY OF A 3-D JET INTRODUCED INTO THE SECONDARY FLOW OF A TURBINE INLET GUIDE VANE [ETUDE EXPERIMENTALE ET THEORIQUE DUN JET TRIDIMENSIONNEL INTRODUIT DANS LECOULEMENT SEONDAIRE DUNE GREILLE DISTRIBUTRICE DE TURBINE]

A. Onvani, C. Ollivier, F. Bario, and F. Leboeuf *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 18 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N86-29790# National Transportation Safety Board, Washington, D. C.

SAFETY RECOMMENDATION

Jim Burnett 28 Mar. 1986 2 p
(NTSB-A-86-22; NTSB-A-86-23; Rept-4346/I-60A) Avail: NTIS HC A02/MF A01

On June 25, 1985, a Cessna Model 150 airplane, N704ZS, sustained substantial damage after a loss of engine power in flight forced the pilot to execute an emergency landing at Rushville, Missouri. The National Transportation Safety Board's investigation of the accident disclosed that the power loss occurred because a self-locking nut became disengaged from the bolt that connects the throttle cable rod end to the carburetor throttle arm, permitting the bolt to back out of the bolt hole. Since January 1, 1980, throttle linkages have become disconnected from carburetor throttle arms for similar reasons on seven other Cessna Model 150 airplanes. Additionally, the loss of connecting hardware has caused the separation of engine throttle or mixture controls on Cessna Model 152, 172, 177RG, A188, and U206 airplanes, resulting in six accidents, one incident, and eight service difficulty reports. Author

N86-29791# National Transportation Safety Board, Washington, D. C.

NATIONAL TRANSPORTATION SAFETY BOARD SAFETY RECOMMENDATION

7 Apr. 1986 6 p
(NTSB-4360/33) Avail: NTIS HC A02/MF A01

Problems that have been experienced by the Pratt & Whitney Aircraft JT8D-1 through -17AR engines are discussed. Thses problems include failures of combustion chambers, removable

sleeve spacers in the high-pressure compressor, combustion chamber outer cases, second-stage low-pressure turbine disks, second-stage fan blades, and high-pressure and low-pressure turbine blades. Author

N86-29792# National Transportation Safety Board, Washington, D. C.
NATIONAL TRANSPORTATION SAFETY BOARD SAFETY RECOMMENDATION
17 Apr. 1986 2 p
(NTSB-4357/1) Avail: NTIS HC A02/MF A01

On July 16, 1984, a Hiller Aviation UH-12E helicopter, N1043L, crashed while engaged in an agricultural spraying operation near Redmond, Oregon. The helicopter was destroyed. The pilot, the sole occupant, received minor injuries. The investigation by the National Transportation Safety Board revealed that an outboard section of main rotor blade had separated in flight. Subsequent detailed examination of the fractured surfaces of main rotor blade spar in the Safety Board's metallurgical laboratory revealed that a fatigue crack had propagated through 80 percent of the spar cross section prior to separation. The fatigue crack originated at the interface between the spar lower surface leading edge and the external spar doubler. The failed blade was manufactured by the Parsons Company, a Hiller Aviation vendor, in the 1960's. The Safety Board understands that this was the fourth such blade failure since the AD was issued. All four failures reportedly occurred when the blades had accumulated about 4,000 hours, although the approved service life of the PN 2253-1101-04 blade is 6,600 hours. The inspection now being conducted at 100-hour intervals apparently is not adequate to identify fatigue crack propagation originating at the interface between the spar lower surface leading edge and the external spar doubler. The Safety Board concludes that a one-time inspection using ultrasonic or eddy current techniques should be imposed on the remaining Parsons main rotor blades with more than 3,000 hours of accumulated time, in addition to the existing AD requirement. Data from this one-time inspection program should be evaluated to determine if any further nondestructive tests are necessary or if the approved service life of the blades should be reduced. Author

N86-29793# Federal Aviation Administration, Washington, D.C. Emergency Evacuation Task Force.
TASK FORCE REPORT ON EMERGENCY EVACUATION OF TRANSPORT AIRPLANES, VOLUME 1 Final Summary Report
Jul. 1986 109 p
(DOT/FAA/VS-86/1.1) Avail: NTIS HC A06/MF A01

This is one of two volumes that report on the study of the emergency evacuation of transport airplanes that was sponsored by the Federal Aviation Administration (FAA). The study included the September 1985 Public Technical Conference and the public meetings of the three technical working groups formed during the conference as part of a task force effort. The working groups are: Design and Certification, Training and Operations, and Maintenance and Reliability. The task force program focused on the reassessment of existing Federal Aviation Regulations pertaining to emergency evacuation. Topics considered in the study include: evacuation demonstrations; emergency exits; evacuation slide certification, inspection, and maintenance; emergency equipment; crewmember training and duties; passenger safety information; air carrier operations; and others. Volume I, Summary Report, summarizes the issues considered during the study and the outcome of those issues. Volume II, Supporting Documentation, contains meeting reports, formal presentation papers, and other documents on which the summary report is based. Author

N86-29794# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
HALON EXTINGUISHER AGENT BEHAVIOR IN A VENTILATED SMALL AIRCRAFT Final Report, Mar. - Jul. 1984
G. R. Slusher, J. Wright, and J. E. Demaree Jun. 1986 53 p
(DOT/FAA/CT-86/5) Avail: NTIS HC A04/MF A01

Hand held fire extinguishers (Halon 1211 and Halon 1301) were evaluated in a four-passenger Cessna Model 210C aircraft. The aircraft was operated in the FAA's Technical Center airflow facility under simulated flight conditions. Extinguishers were discharged without fires to determine the dissipation rate and toxicity levels of Halon extinguishing agents. Agent concentrations dissipated rapidly. Analysis of dose calculations demonstrated that 2.5 pound Halon 1211 and 3.0 pound Halon 1301 extinguishers were safe in the four-passenger test aircraft. Dose calculations for the pilot were a maximum of 60 percent of the limit for Halon 1211, and maximum dose was 31 percent of the limit for Halon 1301. Stratification of the Halons together with cabin ventilation resulted in safe conditions for the pilot. Distribution of extinguishing agents under the instrument panel was investigated. When the extinguishers were discharged on either the pilot's or the copilot's side, four percent concentration was measured on the side opposite of the discharge of the extinguishers. Extinguisher gas stratification was determined by measuring agent levels on the cabin floor. Author

N86-29795# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FULL-SCALE TRANSPORT CONTROLLED IMPACT DEMONSTRATION PROGRAM PHOTOGRAPHIC/VIDEO COVERAGE Final Report, May 1983 - Dec. 1984
John D. Gregoire Apr. 1986 430 p
(Contract DTFA03-80-A-00215)
(DOT/FAA/CT-85/35; JPL-D-2534) Avail: NTIS HC A19/MF A01

The Full-Scale Transport Controlled Impact Demonstration Program was recorded on both film and video tape by the Photo-Duplication Section 642 of the Jet Propulsion Laboratory, California Institute of Technology. Photographic coverage was requested by the Federal Aviation Administration (FAA) on the antimisting kerosene (AMK) fuel and crashworthiness experiments. Instrumentation and documentation cinematography and videography produced a catalog of images that recorded completely the pre-/post-elements of the event. Author

N86-29796# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
INVESTIGATION OF HAZARDS OF HELICOPTER OPERATIONS AND ROOT CAUSES OF HELICOPTER ACCIDENTS Final Report, Oct. 1983 - Sep. 1985
Franklin R. Taylor and Richard J. Adams Jul. 1986 177 p
(Contract DTFA01-80-C-10080)
(FAA/PM-86/28) Avail: NTIS HC A09/MF A01

During 1983 and 1984, Systems Control Technology, Inc. conducted a country-wide survey of civil helicopter pilot organizations involved in a wide range of helicopter operations for the purpose of determining the hazards of the latter and the root causes of the high rate of helicopter accidents. The survey was conducted through personal interviews, meetings, and questionnaires. The questionnaire included census data, profiles of the pilot work environment and procedures,and their own perspectives on the hazards of helicopter operations and causes of helicopter accidents. These data were compared with historical National Transportation Safety Board accident reports and accident briefs to determine more specifically the causes of helicopter accidents. The results of the analysis include a list of hazards and probable causes of accidents, as well as technological, training and standardization remedies. Author

N86-29797# Federal Aviation Administration, Washington, D.C. Associate Administrator for Aviation Standards.
TASK FORCE REPORT ON EMERGENCY EVACUATION OF TRANSPORT AIRPLANES. VOLUME 2: SUPPORTING DOCUMENTATION Final Report
Jul. 1986 429 p
(FAA/VS-86/1,2) Avail: NTIS HC A19/MF A01

This is one of two volumes that report on the study of the emergency evacuation of transport airplanes that was sponsored by the Federal Aviation Administration (FAA). The study included the September 1985 Public Technical Conference and the public meetings of the three technical working groups formed during the conference as part of a task force effort. The working groups are:

Design and Certification, Training and Operations, and Maintenance and Reliability. The task force program focused on the reassessment of existing Federal Aviation Regulations pertaining to emergency evacuation. Topics considered in the study include: evacuation demonstrations; emergency exits; evacuation slide certification, inspection and maintenance; emergency equipment, crewmember training and duties; passenger safety information; air carrier operations, and others. Volume I, Summary Report, summarizes the issues considered during the study and the outcome of those issues. Volume II, Supporting Documentation, contains meeting reports and other documents on which the summary report is based. Author

N86-29798# Scientific Systems, Inc., Cambridge, Mass.
VECTORED THRUST DIGITAL FLIGHT CONTROL FOR CREW ESCAPE, VOLUME 1 Final Report, 1 Jun. 1982 - 28 Feb. 1985
James V. Carroll and Robert F. Gendron Dec. 1985 215 p
(Contract F33615-C-82-3402)
(AD-A166580; AFWAL-TR-85-3116-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 01/4

Work of Meyer and Cicolani was adapted for application to open seat escape systems in current Air Force fighter aircraft. The control system design is a fully self-contained system whose major on-seat components are: acceleration, rate, attitude and altitude sensors, real-time control logic imbedded on a microprocessor chip, rocket thrusters with thrust vectoring and throttling capability, and various avionics and support subsystem hardware items (e.g., power supply). The control concept is based on a comparison of measured translational and rotational accelerations with desired values; the propulsion system is then configured to provide adequate energy to follow the desired trajectory and simultaneously eliminate acceleration errors. The concept uses nonlinear models and incorporates state and control constraints. This volume contains the detailed documentation of specification development, control logic design, hardware identification, and trade study efforts. Volume II (Ad-A166 596) contains a description of the prototype design, real time breadboard simulation, and the results an d analysis of the verification task. Volume III contains the supporting appendices for volumes I and II. Volume IV details the results of the real time hybrid computer simulation effort. GRA

N86-29799# Scientific Systems, Inc., Cambridge, Mass.
VECTORED THRUST DIGITAL FLIGHT CONTROL FOR CREW ESCAPE, VOLUME 2 Final Report, 1 Jun. 1982 - 28 Feb. 1985
James V. Carroll and Robert F. Gendron Dec. 1985 208 p
(Contract F33615-82-C-3402)
(AD-A166596; AFWAL-TR-85-3116-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 01/4

Work of Meyer and Cicolani was adapted for application to open seat escape systems in current Air Force fighter aircraft. The control system design is a fully self-contained system whose major on-seat components are: acceleration, rate, attitude and altitude sensors, real-time control logic imbedded on a microprocessor chip, rocket thrusters with thrust vectoring and throttling capability, and various avionics and support subsystem hardware items (e.g., power supply). The control concept is based on a comparison of measured translational and rotational accelerations with desired values; the propulsion system is then configured to provide adequate energy to follow the desired trajectory and simultaneously eliminate acceleration errors. The concept uses nonlinear models and incorporates state and control constraints. Volume I (AD-A166580) contains the detailed documentation of specification development, control logic design, hardware identification, and trade study efforts. Volume II contains a description of the prototype design, real time breadboard simulation, and the results and an alysis of the verification task. GRA

N86-30019# Boeing Co., Seattle, Wash.
CURRENT DESIGN PROCEDURES FOR MINIMIZING POST CRASH FIRE HAZARDS
H. Skavdahl *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 261-276 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

N86-30020# Aviation Fuel Safety Co., Chelmsford, Mass.
AMINE-CO2 ADDUCTS AS AVIATION FUEL GELLING AGENTS
William W. Bannister *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 279-298 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

N86-30022# Akron Univ., Ohio.
JET FUEL VISCOSITY AT LOW TEMPERATURES WITH NOTES ON n-ALKALINE CRYSTALS Final Report
Dale Schruben *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 317-356 (For primary document see N86-30007 21-28)
(Grant NAG3-488)
(NASA-CR-174911; NAS 1.26:174911) Avail: NTIS HC A17/MF A01 CSCL 21D

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N86-29800*# University of Southern Colorado, Pueblo. School of Applied Science and Engineering Technolo
TECHNOLOGY RESEARCH FOR STRAPDOWN INERTIAL EXPERIMENT AND DIGITAL FLIGHT CONTROL AND GUIDANCE Final Technical Report, 1 Oct. 1979 - 31 Dec. 1984
Ralph A. Carestia and Don E. Cottrell 1985 113 p
(Contract NCC2-41)
(NASA-CR-176907; NAS 1.26:176907) Avail: NTIS HC A06/MF A01 CSCL 17G

A helicopter flight-test program to evaluate the performance of Honeywell's Tetrad - a strapdown, laser gyro, inertial navitation system is discussed. The results of 34 flights showed a mean final navigational velocity error of 5.06 knots, with a standard deviation of 3.84 knots; a corresponding mean final position error of 2.66 n.mi., with a standard deviation of 1.48 n.m.; and a modeled mean-position-error growth rate for the 34 tests of 1.96 knots, with a standard deviation of 1.09 knots. Tetrad's four-ring laser gyros provided reliable and accurate angular rate sensing during the test program and on sensor failures were detected during the evaluation. Criteria suitable for investigating cockpit systems in rotorcraft were developed. This criteria led to the development of two basic simulators. The first was a standard simulator which could be used to obtain baseline information for studying pilot workload and interactions. The second was an advanced simulator which integrated the RODAAS developed by Honeywell into this simulator. The second area also included surveying the aerospace industry to determine the level of use and impact of microcomputers and related components on avionics systems. M.G.

N86-29801# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
INVESTIGATIONS FOR IMPROVING OPERATIONAL RELIABILITY AND MAINTAINABILITY OF INSTRUMENT LANDING SYSTEM COMPONENTS. VOLUME 1: TEXT AND APPENDICES Final Report, Feb. 1983 - Feb. 1986
Richard H. McFarland, Walter D. Phipps, Larry D. Brady, Jeff Dennis, and Joe D. Longworth Feb. 1986 272 p
(Contract DTFA01-83-C-20025)
(DOT/FAA/PM-86/7,1-Vol-1; OU/AEC/EER-79-1-Vol-1) Avail: NTIS HC A12/MF A01

An investigation of anomalous performance of the glide slope at Lambert-St. Louis is reported. An analysis of the Instrument Landing System (ILS) Reference Datum Heights (RDH) is reported, as well as the results of an investigation of glide slope critical

areas. The feasibility of developing ground bases checking techniques for validating the Sideband Reference (SBR) glide slope is presented as well as an assessment of the current standards and tolerances used to qualify glide slope structure. In addition, a proposed methodology for mathematical model validation is discussed. Author

N86-29802# Federal Aviation Administration, Washington, D.C.
ENGINEERING PERFORMANCE EVALUATION OF SMALL COMMUNITY AIRPORT MICROWAVE LANDING SYSTEM (TI-MODEL) AT PHILADELPHIA INTERNATIONAL AIRPORT RUNWAY 17 Final Report
G. D. Adams and C. E. Richardson Aug. 1986 68 p
(Contract DTFA01-82-Y-10521)
(FAA/PM-86/24) Avail: NTIS HC A04/MF A01

The Microwave Landing System (MLS) program is designed to meet both civil and military operational needs. It will eventually replace the Instrument Landing System (ILS). After a system/equipment development phase, the Federal Aviation Administration in 1979 began a Service Test And Evaluation Program (STEP) to obtain experience for developing criteria for siting, installation and preliminary operational procedures. Feasibility demo ground equipment from the development phase was used and user aircraft were equipped with MLS receivers. This report contains engineering evaluation of the FAA Technical Center flight test data taken on the Texas Instruments' manufactured Small Community MLS, as installed for STEP at Philadelphia International Airport Runway 17. The equipment performance was found to generally meet the FAA-STD-022b Path Following Error and Control Motion Noise requirement, but not the linearity requirement. Apparent aircraft propeller induced noise effects were identified. Author

N86-29803# Naval Postgraduate School, Monterey, Calif.
SOME NAVIGATION AND ALMANAC ALGORITHMS M.S. Thesis
Rex H. Shudde Sep. 1985 57 p
(AD-A165840; NPS55-85-023) Avail: NTIS HC A04/MF A01 CSCL 17/7

A detailed discussion is presented of the use of the general spherical triangle as a means of eliminating the many special cases of quadrant determination that plague most navigation computations and steal memory from computer programs. Also included are two programs, NAVALGOR and NAVEPHM which are written for the Radio Shack TRS-80 Model 4 Computer. NAVALGOR implements three sets of computational procedures: direct solution algorithms for speroid and spherical earth models, inverse solution algorithms for spheroid and spherical earth models, and rhumb line approximations to great circle routes. NAVEPHM implements a procedure for the determination of the position of the Sun, Moon and navigational planets that reproduce The Nautical Almanac and The Air Almanac to within 0.2'. GRA

N86-29804# Mitre Corp., McLean, Va.
THE CONCEPT OF ALMOST-PARALLEL IFR (INSTRUMENT FLIGHT RULES) APPROACHES TO PARALLEL RUNWAYS
Armando C. Silva Mar. 1986 52 p
(Contract DTFA01-84-C-00001)
(AD-A166485; MTR-86W11; FAA-DL5-86-1) Avail: NTIS HC A04/MF A01 CSCL 01/2

Under today's rules independent parallel approaches are restricted to runways separated by at least 4300 feet. Currently the FAA is investigating a proposal to achieve reductions down to 3000 feet with the use of an improved surveillance system (1 milliradian accuracy/1 second update). This paper proposes new procedures to achieve such reduction, using existing radars, by executing almost-parallel MLS or ILS approaches. Almost-parallel approaches include curved paths where very shallow rates of turn are required and offset straight paths where the angle of offset with respect to the extended runway centerline is less than 3 degrees. Some issues of concern that arise, such as blunder resolution and pilot's loss of sight of other approach course during curved approaches, are discussed in this paper. Alternatives for an early implementation and site-specific sample applications are presented. The objective of this paper is to present in a concise manner this preliminary concept that has already generated some interest as a solution to reduced parallel operations. As with any new concept, analysis by all concerned parties have to be performed followed by simulations and/or demonstrations before the concept can be considered implementable. Author (GRA)

N86-29805# Air Command and Staff Coll., Maxwell AFB, Ala.
WILL THE USAF NEED GROUND-BASED AIR TRAFFIC CONTROL RADAR IN THE YEAR 2000?
George L. Varn Apr. 1986 49 p
(AD-A166504; AD-E750871; ACSC-86-2585) Avail: NTIS HC A03/MF A01 CSCL 17/7

Advanced technology in military aviation is developing rapidly. The Global Positioning System (GPS) and Microwave Landing System (MLS) will give the pilot precision navigation capability when fully deployed in the 1990s. The Joint Tactical Information Distribution System (JTIDS) will give the pilot the capability to display enemy and friendly aircraft in his area in his cockpit. At the same time, our mobile air traffic control (ATC) radars are aging and need to be replaced. But, with the new technology in the cockpit, it may be more feasible to eliminate ground-based ATC radar and let the pilot do his own ATC from the cockpit. This study examines the feasibility of a cockpit-based ATC system by looking at the requirement for military ATC, specific capabilities that new technologies give the pilot, and human considerations in a cockpit-based ATC system. The study concludes that a cockpit-based ATC system is not feasible and that there will be a need for ground-based ATC radar, at least through the year 2000.
Author (GRA)

N86-29806# Lear Siegler, Inc., Grand Rapids, Mich. Inst. Div.
OPERATING AND SUPPORT HAZARD ANALYSIS FOR THE SELF-CONTAINED NAVIGATION SYSTEM LSI MODEL 6216A, B AND C GROUP A
John T. Reeves 13 Mar. 1986 20 p
(Contract F09603-85-C-1224)
(AD-A166815; GRR-6216-014) Avail: NTIS HC A02/MF A01 CSCL 17/7

This document constitutes the Operating and Support Hazard Analysis (O&SHA) for the C-130 Self-Contained Navigation System (SCNS) installation. It provides a hazard assessment of use and maintenance of the SCNS installation. The purpose of an O&SHA is to identify and control hazards to personnel and to the system, or related to production, installation, maintenance, test, operation, etc. This O&SHA is limited to installation and checkout of the A-kits and system and to the safety of personnel working in or around the equipment, including ground and flight crews. The scope of this analysis for Data Item 0103 is limited to the SCNS installation task 'A-kit' components (viz. wiring harness, brackets, racks, control panels, relay boxes, circuit breakers), B-kit components (viz. ICDUs, BICU, DVS, INU), and the physical interfaces with existing equipment (viz. CACD or Sensors, Radar, Air Data Sensors). These items will be analyzed in respect to safe installation, safe hardware, and safe usage (viz. installation, removal, in-place test, and handling). GRA

N86-29807# Lear Siegler, Inc., Grand Rapids, Mich. Inst. Div.
SUBSYSTEM HAZARD ANALYSIS FOR THE LSI MODELS 6216A, B AND C SELF-CONTAINED NAVIGATION SYSGEM GROUP A
John T. Reeves 13 Mar. 1986 19 p
(Contract F09603-85-C-1224)
(AD-A166816; GRR-6216-013) Avail: NTIS HC A02/MF A01 CSCL 09/5

This document constitutes the Subsystem Hazard Analysis (SSHA) for the C-130 Self-Contained Navigation System (SCNS) installation. It provides a safety assessment of the SCNS installation. The purpose of an SSH is to evaluate the parts making up a system for items that could adversely affect the system safety through component failure, performance degradation, functional failure and inadvertent operation. The scope of this analysis for Data Item 0103 is limited to the SCNS installation task A kit

components (viz. wiring harness, brackets, racks control panels, relay boxes, circuit breakers), B-kit components (viz., ICDUs, BICU, DVS, INU), and the physical interfaces with existing equipment (viz., CADC or Sensors, Radar, Air Data Sensors). These items will be analyzed in respect to safe installation, safe hardware, and safe usage (viz. installation, removal, in-place test, and handling). GRA

N86-29808# Oak Ridge National Lab., Tenn.
PROCEEDINGS OF THE 2ND WORKSHOP ON PLANNING AND SENSING FOR AUTONOMOUS NAVIGATION
E. S. Howe, ed. and C. R. Weisbin, ed. Jan. 1986 195 p Workshop held in Los Angeles, Calif., 18 Aug. 1985
(Contract DE-AC05-84OR-21400)
(DE86-006813; ORNL/TM-9923; CONF-8508163) Avail: NTIS HC A09/MF A01

This report represents the proceedings of the second DOE/CESAR Workshop entitled Planning and Sensing for Autonomous Navigation. The meeting was held August 18 to 19, 1985, in conjunction with, and just prior to the International Joint Conference on Artificial Intelligence at the University of California, Los Angeles. The workshop was organized around several issues developed to focus attention and clarify workshop priorities. The issues dealt with methods for world mapping and discovery in unstructured environments, approaches to real-time planning with sensor feedback, computer architectures and concurrent algorithms, sensor integration, and uncertainty representation and propagation. A series of overview papers contained herein served as background for discussion. Written summaries of group discussions were prepared during the meeting and are included in these proceedings. DOE

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-29809*# Stanford Univ., Calif.
OPTIMAL LANDING OF A HELICOPTER IN AUTOROTATION
Allan Yeow-Nam Lee Jul. 1985 322 p
(Contract NCC2-106)
(NASA-CR-177082; NAS 1.26:177082) Avail: NTIS HC A14/MF A01 CSCL 01C

Gliding descent in autorotation is a maneuver used by helicopter pilots in case of engine failure. The landing of a helicopter in autorotation is formulated as a nonlinear optimal control problem. The OH-58A helicopter was used. Helicopter vertical and horizontal velocities, vertical and horizontal displacement, and the rotor angle speed were modeled. An empirical approximation for the induced velocty in the vortex-ring state were provided. The cost function of the optimal control problem is a weighted sum of the squared horizontal and vertical components of the helicopter velocity at touchdown. Optimal trajectories are calculated for entry conditions well within the horizontal-vertical restriction curve, with the helicopter initially in hover or forwared flight. The resultant two-point boundary value problem with path equality constraints was successfully solved using the Sequential Gradient Restoration Technique. Author

N86-29810*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Applied Mechani
FLAP-LAG-TORSIONAL DYNAMICS OF HELICOPTER ROTOR BLADES IN FORWARD FLIGHT Final Report, Jan. 1984 - Jun. 1986
M. R. M. CrespodaSilva Jun. 1986 6 p
(Grant NAG2-274)
(NASA-CR-176976; NAS 1.26:176976) Avail: NTIS HC A02/MF A01 CSCL 01C

A perturbation/numerical methodology to analyze the flap-lead/lag motion of a centrally hinged spring restrained rotor blade that is valid for both hover and for forward flight was developed. The derivation of the nonlinear differential equations of motion and the analysis of the stability of the steady state response of the blade were conducted entirely in a Symbolics 3670 Machine using MACSYMA to perform all the lengthy symbolic manipulations. It also includes generation of the fortran codes and plots of the results. The Floquet theory was also applied to the differential equations of motion in order to compare results with those obtained from the perturbation analysis. The results obtained from the perturbation methodology and from Floquet theory were found to be very close to each other, which demonstrates the usefullness of the perturbation methodology. Another problem under study consisted in the analysis of the influence of higher order terms in the response and stability of a flexible rotor blade in forward flight using Computerized Symbolic Manipulation and a perturbation technique to bypass the Floquet theory. The derivation of the partial differential equations of motion is presented. B.G.

N86-29811*# Bio-Dynamics Research and Development Corp., Eugene, Oreg.
FEASIBILITY STUDY FOR ERGONOMIC ANALYSIS AND DESIGN OF FUTURE HELICOPTER COCKPIT SYSTEMS
Harold L. Hawkins May 1985 52 p
(Contract NAS2-12056)
(NASA-CR-176942; NAS 1.26:176942) Avail: NTIS HC A04/MF A01 CSCL 01C

The Army's light scout-attack helicopters (LHXs), planned for deployment in the 1990's, will fly nap-of-the-earth (NOE) missions in high threat environments, often under poor visibility and adverse atmospheric conditions, and probably with a one man crew. A procedure for the analysis of pilot workload that will identify and explicate the main characteristics of those LHX mission components holding overload potential is described. A principled, in-depth, explication of the cognitive demans of LHX piloting is essential to any effective effort to address the human factors issues. A task-analytic procedure that will yield the detail and organizstion needed to achieve these goals is examined. B.G.

N86-29812*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
STUDY OF NEW FLIGHT TEST TECHNIQUES Final Report
Dirk Deam Aug. 1984 29 p
(Grant NsG-4019)
(NASA-CR-176952; NAS 1.26:176952; KU-FRL-407-10) Avail: NTIS HC A03/MF A01 CSCL 01C

The modification and testing of a small electromechanical vibrator are described. The vibrator was designed for the flutter testing of aircraft wings and was built to specifications that make it compatible with the X-29 experimental aircraft. The device uses alternating electromagnetic forces to move a magnetic mass and produce vibration. Its unconventional way of producing vibration avoids the need for complex mechanisms and makes efficient use of space and weight. B.G.

N86-29813*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FLIGHT CONTROL SYSTEM DEVELOPMENT AND FLIGHT TEST EXPERIENCE WITH THE F-111 MISSION ADAPTIVE WING AIRCRAFT
Richard R. Larson Aug. 1986 21 p To be presented at the AIAA Guidance, Navigation, and Control Conference, Williamsburg, Va., 18-20 Aug. 1986
(NASA-TM-88265; H-1366; NAS 1.15:88265; AIAA-86-2237-CP) Avail: NTIS HC A02/MF A01 CSCL 01C

The wing on the NASA F-111 transonic aircraft technology airplane was modified to provide flexible leading and trailing edge flaps. This wing is known as the mission adaptive wing (MAW) because aerodynamic efficiency can be maintained at all speeds. Unlike a conventional wing, the MAW has no spoilers, external flap hinges, or fairings to break the smooth contour. The leading edge flaps and three-segment trailing edge flaps are controlled by a redundant fly-by-wire control system that features a dual digital

primary system architecture providing roll and symmetric commands to the MAW control surfaces. A segregated analog backup system is provided in the event of a primary system failure. This paper discusses the design, development, testing, qualification, and flight test experience of the MAW primary and backup flight control systems. Author

N86-29814*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT TEST OF A DECOUPLER PYLON FOR WING/STORE FLUTTER SUPPRESSION
F. W. Cazier, Jr. and M. W. Kehoe (National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.) Jul. 1986 14 p Presented at the AIAA 3rd Flight Testing Conference, Las Vegas, Nev., 2-4 Apr. 1986
(NASA-TM-87767; NAS 1.15:87767) Avail: NTIS HC A02/MF A01 CSCL 01B

The decoupler pylon is a NASA concept of passive wing-store flutter suppression achieved by providing a low store-pylon pitch frequency. Flight tests were performed on an F-16 aircraft carrying on each wing an AIM-9J wingtip missile, a GBU-8 bomb near midspan, and an external fuel tank. Baseline flights with the GBU-8 mounted on a standard pylon established that this configuration is characterized by an antisymmetric limited amplitude flutter oscillation within the operational envelope. The airplane was then flown with the GBU-8 mounted on the decoupler pylon. The decoupler pylon successfully suppressed wing-store flutter throughout the flight envelope. A 37-percent increase in flutter velocity over the standard pylon was demonstrated. Maneuvers with load factors to 4g were performed. Although the static store displacements during maneuvers were not sufficiently large to be of concern, a store pitch alignment system was tested and performed successfully. One GBU-8 was ejected demonstrating that weapon separation from the decoupler pylon is normal. Experience with the present decoupler pylon design indicated that friction in the pivoting mechanism could affect its proper functioning as a flutter suppressor. Author

N86-29815*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN AND FABRICATION OF LARGE SUCTION PANELS WITH PERFORATED SURFACES FOR LAMINAR FLOW CONTROL TESTING IN A TRANSONIC WIND TUNNEL
Dal V. Maddalon and William A. Poppen, Jr. Aug. 1986 67 p
(NASA-TM-89011; NAS 1.15:89011) Avail: NTIS HC A04/MF A01 CSCL 01C

Considerable progress has been made in the development of perforated suction surface material for laminar flow control applications. Electron-beam perforated titaniuum skin was used as the suction surface. Critical issues related to suction panel manufacturing were identified and largely resolved. The final product included fabrication of a 7-foot chord by 7-foot span perforated laminar flow control wind tunnel model. Techniques used can be adapted to modern aircraft production lines. The report includes details on panel instrumentation and other features required for testing in a transonic pressure tunnel. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N86-29816# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
ANALOGUE SIGNAL CONDITIONING FOR FLIGHT TEST INSTRUMENTATION
D. W. Veatch and R.K. Bogue Apr. 1986 179 p
(AGARD-AG-160-Vol-17; ISBN-92-835-1520-X) Avail: NTIS HC A09/MF A01

The application of analog signal conditioning to flight-test data-acquisition systems is discussed. Emhasis is placed on practical applications of signal conditioning for the most common flight-test data-acquisition systems. A limited amount of theoretical discussion is included to assist the reader in a more complete understanding of the subject matter. Nonspecific signal conditioning, such as amplification, filtering, and multiplexing, is discussed. Signal conditioning for various specific transducers and data terminal devices is also discussed to illustrate signal conditioning that is unique to particular types of transducers. The purpose is to delineate for the reader the various signal-conditioning technique options, together with tradeoff considerations, for commonly encountered flight-test situations. Author

N86-29817# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
IMPROVING THE INTERPRETABILITY OF AN AIRCRAFT ATTITUDE INDICATOR M.S. Thesis
Mark A. DiPadua 1986 59 p
(AD-A166329; AFIT/CI/NR-86-27T) Avail: NTIS HC A04/MF A01 CSCL 01/4

Two display types and four aircraft size ratios were investigated in this thesis to determine their effect on attitude display interpretability. The two display designs used were an outside-in (moving plane) and an inside-out (moving horizon) display. The four aircraft symbol lengths were measured relative to the size of the artificial horizon (33 percent, 50 percent, 67 percent, 100 percent). Twenty flight naive subjects were tested in two phases with both display types and all four size ratios. The first phase tested subjects' reaction to the sudden awareness of a change in attitude. The dependent variables measured, reaction time and error rate, indicated a preference for the outside-in display. The small size ratio was significantly better than the larger ones with reaction time as the dependent variable. A significant difference between sizes was not the case when the dependent variable error rate was measured. The second phase consisted of a dynamic flying task on an Apple PC computer. The dependent measures were the root mean square (RMS) error due to roll and the RMS error due to pitch. A significant difference in display types, favoring the outside-in type, was found with the RMS error due to roll as the dependent measure. No significant differences were found when the RMS error due to pitch was used as the dependent measure. Sizes did, however, approach significance in this case. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-29818*# Oklahoma Univ., Norman.
TRANSMISSION LINE DESIGN FOR A POWER DISTRIBUTION SYSTEM AT 20 kHz FOR AIRCRAFT
Leon W. Zelby, John B. Mathes, and John W. Shawver Washington NASA Jul. 1986 38 p
(Grant NAG3-508)
(NASA-CR-3987; NAS 1.26:2987) Avail: NTIS HC A03/MF A01 CSCL 21E

A low inductance, low characteristic impedance transmission line was designed for a 20 kHz power distribution system. Several different conductor configurations were considered: strip lines, interdigitated metal ribbons, and standard insulated wires in multiwire configurations (circular and rectangular cylindrical arrangements). The final design was a rectangular arrangement of multiple wires of the same gauge with alternating polarities from wire to wire. This offered the lowest inductance per unit

length (on the order of several nanohenries/meter) and the lowest characteristic impedance (on the order of one Ohm). Standard multipin connectors with gold-plated elements were recommended with this transmission line, the junction boxes to be internally connected with flat metal ribbons for low inductance, and the line to be constructed in sections of suitable length. Computer programs for the calculation of inductance of multiwire lines and of capacitances of strip lines were developed. Author

N86-29819*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
MULTI-VARIABLE CONTROL OF THE GE T700 ENGINE USING THE LQG/LTR DESIGN METHODOLOGY
William H. Pfeil (General Electric Co., Lynn, Mass.), Michael Athans, and H. Austin Spang, III (General Electric Co., Schenectady, N.Y.) Apr. 1986 16 p
(Grant NAG2-297)
(NASA-CR-177080; NAS 1.26:177080; LIDS-P-1547) Avail: NTIS HC A02/MF A01 CSCL 21E

The design of scalar and multi-variable feedback control systems for the GET700 turboshaft engine coupled to a helicopter rotor system is examined. A series of linearized models are presented and analyzed. Robustness and performance specifications are posed in the frequency domain. The linear-quadratic-Gaussian with loop-transfer-recovery (LQG/LTR) methodology is used to obtain a sequence of three feedback designs. Even in the single-input/single-output case, comparison of the current control system with that derived from the LQG/LTR approach shows significant performance improvement. The multi-variable designs, evaluated using linear and nonlinear simulations, show even more potential for performance improvement. Author

N86-29820*# Wu (Jiunn-Jenq), Sierra Madre, Calif.
EXPERIMENTS ON HIGH SPEED EJECTORS
Jiunn-Jenq Wu Jul. 1986 82 p
(NASA Order A40174-C; Contract F49620-81-C-0043)
(NASA-CR-177419; NAS 1.26:177419) Avail: NTIS HC A05/MF A01 CSCL 21E

Experimental studies were conducted to investigate the flow and the performance of thrust augmenting ejectors for flight Mach numbers in the range of 0.5 to 0.8, primary air stagnation pressures up to 107 psig (738 kPa), and primary air stagnation temperatures up to 1250 F (677 C). The experiment verified the existence of the second solution ejector flow, where the flow after complete mixing is supersonic. Thrust augmentation in excess of 1.2 was demonstrated for both hot and cold primary jets. The experimental ejector performed better than the corresponding theoretical optimal first solution ejector, where the mixed flow is subsonic. Further studies are required to realize the full potential of the second solution ejector. The research program was started by the Flight Dynamics Research Corporation (FDRC) to investigate the characteristic of a high speed ejector which augments thrust of a jet at high flight speeds. Author

N86-29821# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
INVESTIGATION OF SURFACE STRAINS IN FIR TREE TURBINE BLADE ATTACHMENTS M.S. Thesis
Joseph P. Marksteiner 1985 86 p
(AD-A166330; AFIT/CI/NR-86-7T) Avail: NTIS HC A05/MF A01 CSCL 21/5

Surface strains in the fillet regions of test model specimens of fir tree turbine blade attachments were examined. The fir tree specimens are loaded under cyclic tension-tension in the elastic range. The strains were recorded with an interferometric technique at the center and near the edges of the exposed unloaded face of the fir tree. Data were recorded for a total of over 700 load cycles on 23 differecnt specimenns. Two different load bearing surface geometries were investigaed. The effect of machining tolerances were determined for both geometries. The load split between the two sets of load bearing surfaces was determined. Actual strains were compared to those predicted by superposition of strain fields. Stresses computed from the recorded strains were compared to photoelastic and finite element analyses. GRA

N86-29822# Department of the Air Force, Washington, D.C.
SELF-RETAINED PLATFORM COOLING PLATE FOR TURBINE VANE Patent Application
Stephen N. Finger, inventor (to Air Force) Filed 13 Nov. 1985 13 p
(AD-D012218; US-Patent-Appl-SN-797581) Avail: NTIS HC A02/MF A01 CSCL 21/5

A turbine stator vane assembly for gas turbine or turbojet engines has an improved structure for retention of a cooling impingement plate. Two inwardly directed flanges are added to the wall-like extensions extending from the bottom of the platform upon which the vane is mounted. The cooling impingment plate is resiliently snapped into place between pin fins on the bottom of the platform and the flanges. Author (GRA)

N86-29823# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.
HEAT TRANSFER AND COOLING IN GAS TURBINES
Loughton, England Sep. 1985 528 p In ENGLISH and FRENCH Symposium held in Bergen, Norway, 6-10 May 1985
(AGARD-CP-390; ISBN-92-835-0378-3) Avail: NTIS HC A23/MF A01

Heat transfer and cooling in gas turbines is one of the crucial fields in the quest for higher performance as well as life and reliability. The purpose of this symposium was to bring together experts from industry, research establishments and universities to discuss fundamental and applied heat transfer problems relevant to gas turbines and to exchange practical experience gained in component and engine development and testing. The symposium focussed on turbine blade cooling including the interaction of cooling and aerodynamics. Furthermore, heat transfer in compressors and combustion systems as well as heat exchangers was covered. Emphasis was also placed on heat transfer modeling, experimental techniques, and test facilities. For individual titles, see N86-29824 through N86-29862.

N86-29824# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
COOLING TECHNIQUES FOR GAS TURBINE AIRFOILS: A SURVEY c34
Darryl E. Metzger *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

A brief general background discussion of turbine heat transfer and cooling with compressor discharge air is given. Specific reference is made to a selection of current research areas for gas turbine engine cooling, including blade tip heat transfer, heat transfer in serpentine passages, multiple jet array impingement, heat transfer in pin fin arrays, disk heat transfer, and film cooling. An overview of various experimental methods used to acquire heat transfer data is also given, with an emphasis on newer methods used to acquire detailed local convection heat transfer information. Author

N86-29825# Rolls-Royce Ltd., Bristol (England). Turbine Research and Methods.
ROTATING HEAT TRANSFER INVESTIGATIONS ON A MULTI-PASS COOLING GEOMETRY c34
R. J. Clifford *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The effect of rotation on the heat transfer in a complex 3D multi-pass turbine blade cooling geometry is reviewed. The test rig, the experimental technique and the initial results are discussed in detail. Basic checks at zero rotational speed showed good agreement with data obtained earlier on this model using an alternative transient technique. Rotation was shown to have a significant effect on the heat transfer distribution (+ or - 30%) which when averaged over the gas washed surfaces showed a reduction to 90% of the static value. The effect of these changes on the blade predicted metal temperatures and lives are also

reviewed. Investigations are continuing to fully evaluate the implications of both Coriolis and buoyancy effects on the heat transfer distributions in these complex 3D geometries. M.G.

N86-29826# Hull Univ. (England). Dept. of Engineering Design and Manufacture.

LOCAL AND MEAN HEAT TRANSFER ON THE LEADING AND TRAILING SURFACES OF A SQUARE-SECTIONED DUCT ROTATING IN THE ORTHOGONAL-MODE c34

W. D. Morris and S. P. Harasgama (Royal Aircraft Establishment, Farnborough (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

The results of an experimental study of local and mean heat transfer over the leading and trailing surfaces of a square-sectioned duct which is constrained to rotate about an axis perpendicular to the main direction of through flow are described. Both radially outward and inward coolant flow conditions are considered. Physical arguments are discussed which explain the data trends found in terms of Coriolis-induced secondary flows and rotational buoyancy and these trends are compared with the corresponding problem in circular-sectioned tubes. Author

N86-29827# Pratt and Whitney Aircraft of Canada Ltd., Longueuil (Quebec).

PRESSURE DROP AND HEAT TRANSFER CHARACTERISTICS OF CIRCULAR AND OBLONG LOW ASPECT RATIO PIN FINS c34

S. C. Arora and W. Abdel Messeh *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 15 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

The pressure drop and heat transfer characteristics of circular and oblong pin fins of height-to-diameter ratio of unity used to augment internal cooling of gas turbine airfoils are presented. Data were obtained for an array of 10 rows of staggered pin fins in a 25:1 aspect ratio channel, with both pins and channel endwalls forming the heat transfer surface. Results show that the array average friction factor increases with increasing blockage caused by different arrangement of pin fin geometries in the channel. The local heat transfer coefficient increases up to the 3rd row of pin fins and decreases thereafter. Oblong pin fins with gamma=90 deg (major axis parallel to the direction of flow) result in higher heat transfer rates and lower friction factor than the circular pin fins. For other orientations, oblong pin fins do not offer any advantage over circular pin fins for Re < or = 20,000 (typical of small gas turbine engines). M.G.

N86-29828# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

EXTERNAL HEAT TRANSFER STUDY ON A HP TURBINE ROTOR BLADE c34

T. Arts and C. G. Graham (Rolls-Royce Ltd., Bristol (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

An experimental investigation of the effects of Mach number, Reynolds numbers and free stream turbulence intensity on the heat transfer performance of a high pressure gas turbine rotor blade in a stationary linear cascade arrangement is described. This study was undertaken in the von Karman Institute short duration isentropic compression tube facility. The tests were performed for outlet Mach numbers ranging between 0.7 and 1, whereas the outlet Reynolds number was varied between 500,000 and 1,500,000; free stream turbulence levels between 1% and nearly 8% were considered. The experimental results were compared with boundary layer predictions provided by a finite difference program (STAN5), which solves the simplified, two dimensional, steady Navier-Stokes equations. M.G.

N86-29829# Karlsruhe Univ. (West Germany). Lehrstuhl und Inst. fuer Thermische Stroemungsmach

EFFECTS OF WAKES ON THE HEAT TRANSFER IN GAS TURBINE CASCADES c34

S. Wittig, A. Schulz, H. J. Bauer, and K. H. Sill *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

The interaction between consecutive blade rows can be expected to have important effects on the heat transfer in cooled gas turbine cascades. In the present study, the influence of the wake from a blade profile - traversed in front of a cooled gas turbine cascade in planes with varying distances from the leading edge - on the local heat transfer coefficient along the suction and pressure side has been analyzed. The investigation is part of a research program to develop experimentally verified numerical codes for heat transfer calculations. With the aid of a finite element program, the local heat transfer coefficients along the cooled blades are derived from surface and coolant temperature measurements. It is shown that in addition to the axial distances the orientation of the wake with respect to the leading edge is of dominant influence. In particular, the measurements demonstrate with increasing free stream turbulence levels a rapid rise of the heat transfer rate along the pressure surface as well as in the stagnation region. The laminar-turbulent transition is relocated towards the leading edge along the suction surface. The measurements are compared with those derived from flows with grid-produced turbulence. In general, slower transition behaviour is observed than foundwith numerical codes. Author

N86-29830# Oxford Univ. (England). Dept. of Engineering Science.

WAKE-PASSING IN A TURBINE ROTOR CASCADE c34

D. J. Doorly, M. L. G. Oldfield, and C. T. J. Scrivener (Rolls-Royce Ltd., Derby, England) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 18 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

A technique for generating realistic wakes upstream of a stationary turbine blade cascade at full scale Mach numbers and Reynolds numbers is described. High speed Schlieren photographs showing the development of the wake flow through the cascade are presented, together with unique high speed measurements of the fluctuations of the surface heat transfer rate as the nozzle guide vane (NGV) wakes pass over the rotor blade surface. Combining the flow visualization results with the unsteady heat transfer measurements reveals the radically different nature of the boundary layer transition caused by wake passing; an understanding of which will be essential for the development of improved prediction techniques. M.G.

N86-29831# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.

EFFECTS OF HOLE GEOMETRY, WALL CURVATURE AND PRESSURE GRADIENT ON FILM COOLING DOWNSTREAM OF A SINGLE ROW c34

H. Kruse *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

Film cooling with injection through a single row of discrete circular holes is a 3-dimensional process which becomes more and more 2-dimensional with downstream distance from the injection site. In order to develop and verify prediction methods experimental investigations within the mixing region downstream of the coolant injection were undertaken. The measurements discussed in this paper were carried out using simple film cooled models at a mainstream temperature of about 100 C and a coolant temperature of about 30 C. Coolant distributions on the adiabatic wall, adiabatic wall effectiveness and heat transfer coefficients affected by blowing are presented. The blowing parameter was varied from 0.5 to 2 and the pitch to diameter ratio was varied from 1.5 to 5 with a constant hole diameter of 2 mm. Injection angles of 10 deg., 45 deg. and 90 deg. are covered.

A flexible wall was used to produce zero, favorable and adverse pressure gradients along the flat plate. Author

N86-29832# Sussex Univ., Brighton (England).
EFFECTS OF SURFACE ROUGHNESS ON HEAT TRANSFER TO GAS TURBINE BLADES c34
A. B. Turner, F. H. A. Tarada, and F. J. Bayley *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 10 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

A brief, preliminary sample of results of an investigation into the effect of surface roughness on heat transfer to gas turbine blades is presented. Only the kind of roughness due to the accretion of dirt or dust is considered and this has been simulated in cascade flow by attaching various grades of abrasive powders to the blade surface with a water soluble adhesive. A significant increase in heat is reported particularly with high free stream turbulent levels. Roughness on the pressure surface alone is shown to increase the overall heat transfer without any corresponding increase in profile loss. Author

N86-29833# Oxford Univ. (England). Dept. of Engineering Science.
THE EFFECT OF DENSITY RATIO ON THE FILM-COOLING OF A FLAT PLATE c34
C. J. P. Forth, P. J. Loftus, and T. V. Jones *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The effect of varying the ratio of coolant-to-freestream density on the film-cooling process is illustrated. This effect is of great importance since most design data has been acquired at temperature ratios and hence density ratios far removed from those occurring in modern gas turbines. There is no consensus at present on how to scale this data to engine conditions. Experimental data is presented for heat transfer downstream from a single row of 30 degree-inclined film-cooling holes, obtained for air at a wide range of gas-to-coolant temperature ratios. These results exhibit a marked effect of density ratio. Scaling is discussed, and good collapse of data is achieved in the two regimes identified, characterised by weak and strong blowing. Conditions representative of the turbine environment are created using an isentropic light piston tunnel: the Mach number M = 0.55, and the unit Reynolds number Re/m = 2.7 x 10(5)/m. The experiments are unique in that they simulate the gas-to-coolant and gas-to-wall temperature ratios typical of those in gas turbines, producing density ratios hiterto only attained in experiments employing foreign gas injection. Author

N86-29834# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France). Etudes Generales Aerothermiques.
STUDIES OF HEAT TRANSFER ON THE BASE OF TURBINE NOZZLES WITH AND WITHOUT FILM COOLING [ETUDES DES TRANSFERTS THERMIQUES SUR LES PLATES-FORMES DE DISTRIBUTEUR DE TURBINE AVEC ET SANS FILM DE REFROIDISSEMENT] c34
Ann-Elisabeth Bouiguignon *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 9 p In FRENCH (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The severity of the aerothermal environment of high-pressure nozzles in modern engines requires base cooling using techniques similar to those used for guide vanes, i.e., convection, films etc. These experiments measure the exchange coefficients for several bases of different configurations, and which show variations in the film cooling structure; measurement of the characteristics of the flow in the vicinity of the wall is also done. This document presents the analysis of the results obtained, compared with the predicted results. The correlations deduced from this analysis show a general method of determining the thermal transfer coefficients for air injection cooling. M.G.

N86-29835# Rolls-Royce Ltd., Derby (England). Mechanical Technology.
SHROUD SEGMENTS FOR UNSHROUDED BLADE TURBINES c34
R. S. Attwood *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

For hot and high speed turbines it is desirable to use blades without tip shrouds, which are an embarrassment from the point of view of centrifugal weight and cooling. The static shroud segments are then exposed to very severe thermal conditions. It is difficult to design shroud segments which will survive these conditions without demanding so much cooling air that the specific fuel consumption advantage of the shroudless blade is completely absorbed. The problem involves two parameters: cooling requirements and integrity. Therefore, for a variety of possible segment section design concepts, the fundamental relationships which control the cooling requirements are examined. The second part of the paper explains the decision to evaluate experimentally the integrity of section of designs, and a description and technical justification of the chosen test technique, which overcomes the heat-transfer compromises involved in testing at atmospheric pressure. Author

N86-29836# Brown, Boveri und Cie, A.G., Baden (Switzerland).
ENGINE TESTS ON A COOLED GAS TURBINE STAGE c34
H. J. Graf *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 16 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

A new cooling system was designed for the 45 MW gas turbine type 8. Extensive tests were carried out in a new power station to verify the reliability of the cooled components. Wall temperatures were measured using thermocouples, thermal paints and pyrometers. Cooling air temperature, pressure and mass flow measurements allowed a detailed analysis of the first stage under operating conditions. The results and comparisons with design calculations are presented. The applicability and accuracy of the three measuring techniques are discussed. Author

N86-29837# Westinghouse Canada, Inc., Hamilton (Ontario).
HEAT TRANSFER TEST EVALUATION OF THE SHELL-SPAR BLADE COOLING CONCEPT APPLIED TO INDUSTRIAL GAS TURBINES c34
G. P. Butt and W. Edward North (Westinghouse Electric Corp., Concordville, Pa.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 17 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

A series of heat transfer experiments to verify the theoretical prediction techniques adopted for the design of shell-spar cooled turbine vanes and blades is described. Tests were performed on flat plate specimens representing a wide range of channel geometries. Each specimen was installed in one wall of a test section downstream of a combustor which was run at various operating temperatures. A recommended design approach was formulated from analysing the results. The potential of shell-spar cooling applied to industrial gas turbines is discussed. Author

N86-29838# Calspan Advanced Technology Center, Buffalo, N.Y. Physical Sciences Dept.
HEAT-FLUX MEASUREMENTS AND ANALYSIS FOR A ROTATING TURBINE STAGE c34
Michael G. Dunn *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

A measurement and analysis program is described which utilizes: (1) a Garrett TFE 731-2 high-pressure turbine stage and (2) a Garrett low aspect ratio turbine (LART) stage. The major emphasis of this program has been placed on obtaining accurate measurements of heat-flux distributions in the full-scale rotating turbine stage. The experimental technique being used is the

short-duration, shock-tunnel approach, in which fast-response, thin-film thermometers are used to measure the surface temperature histories at prescribed positions on the various component parts. Heat flux values are then inferred from these temperature histories using standard data reduction procedures. A summary and discussion of the TFE 731-2 high pressure turbine results with particular emphasis on nozzle guide vane (NGV) tip endwall data not previously reported are provided. A significantly more brief discussion of the LART stage instrumentation is also included. In addition, a summary discussion of the experimental technique and the associated instrumentation is included. Author

N86-29839# Karlsruhe Univ. (West Germany). Inst. fuer Hydromechanik.
CALCULATION OF LAMINAR-TURBULENT BOUNDARY LAYER TRANSITION ON TURBINE BLADES c34
W. Rodi and G. Scheuerer (Erlangen-Nuremberg Univ. (West Germany).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Calculations are presented for the flow development and heat transfer in transitional two-dimensional boundary layers of relevance to turbine blades. They were obtained with the Patankar-Spalding finite difference program, using a low Reynolds number version of the k-epsilon turbulence model for simulating the turbulent transport. For the higher free-stream turbulence levels prevailing in gas turbines (say above 1%), the model is capable of simulating the physical transition mechanism which is governed by the transport of the turbulent fluctuations from the free stream into the laminar boundary layer. The calculation examples comprise a variety of flat-plate boundary layers with various favorable and adverse pressure gradients as well as various levels of free-stream turbulence, and a simulation of the boundary layer development of an experimentally investigated turbine blade. The calculations are compared with measurements in each case (mainly the distribution of heat transfer coefficients). The agreement is generally good, but the model has a tendency to predict a somewhat faster transition than was observed in the experiments. M.G.

N86-29840# Purdue Univ., West Lafayette, Ind. School of Mechanical Engineering.
A MODEL FOR CORRELATING FLAT PLATE FILM COOLING EFFECTIVENESS FOR ROWS OF ROUND HOLES c34
M. R. LEcuyer and F. O. Soechting (Pratt and Whitney Aircraft, West Palm Beach, Fla.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

An effective method of cooling, that has found widespread application in aircraft gas turbines, is the injection of a film of cooling air through holes into the hot mainstream gas to provide a buffer layer between the hot gas and the airfoil surface. Film cooling has been extensively investigated and the results have been reported in the literature. However, there is no generalized method reported in the literature to predict the film cooling performance as influenced by the major variables. A generalized film cooling correlation has been developed, utilizing data reported in the literature, for constant velocity and flat plate boundary layer development. This work provides a basic understanding of the complex interaction of the major variables effecting film cooling performance. Author

N86-29841# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
COMPUTATION OF THERMAL RADIATION FOR GAS TURBINE CONDITIONS c34
M. G. Carvalho, D. F. G. Durao, and F. C. Lockwood (Imperial Coll. of Science and Technology, London (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 7 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The prediction of the fluid flow, combustion and heat release processes in a 'can' combustion chamber of a gas turbine is addressed. A three-dimensional numerical solution technique is used to solve the governing time-average partial differential equations and the physical modelling for the turbulence, combustion and thermal radiation. The thermal radiation modelling is emphasized in this paper. The implications of neglecting radiative heat transfer in gas turbine combustion chamber calculations are explored and discussed. Author

N86-29842# Sussex Univ., Brighton (England). Thermo-Fluid Mechanics Research Centre.
PREDICTION OF TRANSIENT TEMPERATURES FOR AN AIR-COOLED ROTATING DISC c34
C. A. Long and J. M. Owen *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The numerical solution of Fourier's conduction equation is used to compute the transient temperature distribution in a rotating disc. The convective boundary conditions for the disc surfaces are based on simple formulae obtained from the solutions of the boundary-layer equations, and the computed surface temperatures are compared with measurements made on a rotating-disc rig. Free-disc tests, at rotational Reynolds numbers up to Re sub phi = 2.5 x 10(6), are used to provide a datum from which to judge the numerical method. Although the numerical solution tends to overestimate the cooling rate of the heated free disc at high Reynolds numbers, the agreement between computed and measured temperatures is considered reasonable. Rotating-cavity tests, in which a heated disc is cooled by a radial outflow of air, are used to examine the suitability of the simple convective boundary conditions. As the computed temperatures show reasonable agreement with the measured values, it is suggested that the proposed formulae for convection in a rotating cavity might be useful for design purposes. Author

N86-29843# Norges Tekniske Hoegskole, Trondheim. Dept. of Engineering Thermodynamics.
HEAT TRANSFER IN GAS TURBINE COMBUSTORS: A DISCUSSION OF MATHEMATICAL MODELING OF COMBUSTION, HEAT AND MASS TRANSFER WITH EMPHASIS ON HEAT TRANSFER IN GAS TURBINE COMBUSTORS c34
Bjorn F. Magnussen *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 17 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Heat transfer problems in gas turbine combustors are addressed with particular emphasis given to the treatment of heat generation in the combustor. The heat is generated through chemical reactions that take place when reactants are mixed at molecular scale at sufficient high temperature. It is known that the microscale processes which are decisive for the molecular mixing as well as the dissipation of turbulence energy into heat are severely intermittent, i.e. concentrated into isolated regions whose entire volume is only a small fraction of the volume of the fluid. The paper reviews the eddy dissipation concept (EDC) for chemical reactions in turbulent flow developed by Magnussen. The EDC is a reactor concept which is unique in that it takes into account the intermittent behavior of the small scale structures on the chemical reactions. Both fast and slow chemical reactions can be treated simultaneously. Flame stabilization, extinction and ignition characteristics, as well as blow-off, turbulent flame propagation velocities and reaction rates are discussed in relation to the EDC. Computations of heat transfer rates to the walls taking into a account the cooling effect of the secondary air are demonstrated. The physical implications of the various sub-models are discussed. M.G.

N86-29844# Trent Polytechnic, Nottingham (England). Dept. of Mechanical Engineering.
EFFECTIVENESS MEASUREMENTS FOR A COOLING FILM DISRUPTED BY A SINGLE JET WITH WALL PLUNGING c34
B. L. Button *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 10 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

Experimental measurements of the effectiveness downstream of a slot airflow with the jet airflow normal to the wall were performed in a wind tunnel. The separate and combined effects of the slot and jet airflows with and without wall plunging on the effectiveness and flow characteristics are presented over a range of slot and jet airflow conditions relevant to gas turbine combustors. The slot consisted of three rows of holes inclined at 10 degrees to the main airflow. The jet center line was positioned one, two and three diameters downstream from the slot exit. The jet diameter corresponded to five slot heights. Three wall plunge heights were used and corresponded to : 02, 0.4 and 12 jet diameters. The main airflow was constant at a Mach number of 0.05 and various combinations of the slot mass velocity ratio (0.5, 1.0 and 1.5) with the jet mass velocity ratio (0.5, 1.0 and 2.0) were tested. The effectiveness measurements covered an area eight jet diameters downstream of the slot exit by four jet diameters laterally. The results show that the major interactions between the three airflows occur downstream of the jet center line in a small region about three diameters long and two diameters wide. In general, such interactions reduce the effectiveness by up to forty percent when compared to the values with no jet injection. The combined and the separate effectiveness of the slot airflow and of the jet airflow are presented. Author

N86-29845# Detroit Diesel Allison, Indianapolis, Ind.
ALTERNATE COOLING CONFIGURATIONS FOR GAS TURBINE COMBUSTION SYSTEMS **c34**
D. A. Nealy, S. B. Reider, and H. C. Mongia *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 15 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Work aimed at the synthesis, characterization, and evaluation of several alternate types of advanced wall cooling schemes is reviewed -- specifically, film-convection cooling, laminated porous wall cooling, and angled, multihole (effusion) cooling. The concept definition, heat transfer performance characterization, and design problems associated with each basic concept are reviewed, and relevant rig and engine experience cited. A brief assessment of the structural limitations of the several cooling schemes is also made, together with a review of the key materials and fabrication considerations. M.G.

N86-29846# Leeds Univ. (England). Dept. of Fuel and Energy.
FULL COVERAGE IMPINGEMENT HEAT TRANSFER: THE VARIATION IN PITCH TO DIAMETER RATIO AT A CONSTANT GAPP **c34**
G. E. Andrews, A. A. Asere, C. I. Hussain, and M. C. Mkpadi *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Impingement heat transfer is widely used in turbine blade cooling and is becoming more common in combustion chamber wall cooling. For the latter application, geometries that give impingement cooling of large surface areas are required. The geometrical requirements of full coverage heat transfer for combustion chamber cooling are outlined. A series of hole sizes, D, are investigated at a constant pitch, X, and constant impingement gap Z. The usual practice of keeping Z/D constant as X/D has been varied and has been rejected as unrealistic. Design considerations limit practical values of Z to a fairly narrow range of 2-12 mm and it is shown that over this range, Z, has no influence on the impingement heat transfer. The application of the present type of heat transfer correlation to the prediction of impingement cooling chambers is considered. Measured wall temperature data is presented for an impingement/effusion wall cooling geometry. The heating of the impingement plate by the impingement jets being deflected backwards is identified an as area where no heat transfer correlations exist. At low coolant flow rates the temperature rise of the impingement air as it passes through the impingement plate is significant and unless it is taken into account the impingement cooling effectiveness will be overpredicted. Author

N86-29847# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France). Centre de Villaroche
COOLING TECHNIQUES FOR TURBOJET PRE-HEATER CHANNELS [TECHNIQUES DE FROIDISSEMENT DES CANAUX DE RECHAUFFE DES TURBOREACTEURS] **c34**
M. Desaulty, P. Troullot, and S. Coutor *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 11 p In FRENCH (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Increases in the performance of turbojets with pre-heating are dependent upon technological research in the area of protection of the wall in pre-heater channels. The procedures used to cool the thermal protection jackets have undergone important improvements which have optimized performance, reduced weight and improved cooling efficiency. This report presents a comparison of the thermal protection jackets for several SNECMA engines, as well as the principal stages of development for the jacket from the design stages through static engines tests. M.G.

N86-29848# Oxford Univ. (England). Dept. of Engineering Science.
THE MEASUREMENT OF LOCAL HEAT TRANSFER COEFFICIENTS IN BLADE COOLING GEOMETRIES **c34**
P. T. Ireland and T. V. Jones *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 8 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

An account is given of the experimental technique employed in measuring heat transfer coefficients in blade cooling passages. A hot air flow is suddenly started through a perspex model of the blade cooling passage. The surface temperature of the model is monitored during this time and the internal heat transfer coefficient deduced from this temperature history. Thin and thick walled models are employed and the surface temperature measured using liquid crystal thermochromic indicators. The analysis for the interpretation of the experimental results is given together with the experimental precautions required for the measurement. The use of liquid crystals in this form of transient experiment is discussed. A study of the detailed heat transfer distribution around pedestals and other heat transfer enhancement devices is also described. These devices are tested at approximately x 100 scale in order to obtain the required detail and full scale Reynolds number is simulated. Author

N86-29849# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AN OPTICAL PYROMETER TO MEASURE TURBINE BLADE SURFACE TEMPERATURE **c34**
Marc Charpenel and Jean Wilhem *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 10 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The development of a cooled infrared pyrometric probe, with a high spatial and temporal resolving power, made it possible to establish by pyrometric methods surface temperature charts of the mobile blades of a turbine. The use of a sensor with a 1 sec time constant yields a resulting power on the blade surface of the order of 2 sq mm. This sensor is cooled at -40 C, which ensures a good detectivity and temperature measurements above 450 C. A water cooled metallic tube, ending by a right angle deflecting prism, makes up the light guide of the pyrometer and can be inserted between the various turbine stages. The probe has been designed to withstand the pressure and temperature conditions prevailing in the turbine blade test section, and was subjected without damage to 20 bar and 2100 K. The use of this pyrometer with the expermental turbine specially designed for qualifying new blade cooling methods has shown that pyrometry involves difficulties connected to: the non-zero blade reflection coefficient (emissivity lower than 1); and the gas radiation due to the gases. The above difficulties were analyzed and solutions were proposed; in particular a correcting program for the temperatures was

perfected which takes into account the blade to blade mutual reflections. Author

N86-29850# Massachusetts Inst. of Tech., Cambridge.
HIGH FREQUENCY RESPONSE HEAT FLUX GAUGE FOR METAL BLADING c34
A. H. Epstein, G. R. Guenette, R. J. G. Norton (Rolls-Royce, Inc., Atlanta, Ga.), and Cao Yuzhang (Beijing Inst. of Aeronautics and Astronautics (China).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 16 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Double-sided, high frequency response heat flux gauge technology developed specifically for use on metal turbine blading in short duration turbine test facilities is described in detail. The gauges consist of a metal film (1500A) resistance thermometer sputtered on both sides of a thin (25 micron) polyamide sheet. This sheet, containing 25 gauges, is then adhesively bonded (and completely covers) the airfoil surface. The temperature difference across the polyamide is a direct measure of the heat flux at low frequencies, while a quasi-1D analysis is used to infer the high frequency heat flux from the upper surface temperature history. The design criteria, construction and application techniques, and calibration procedures are discussed in detail. Sample measurements in a high pressure turbine are presented. Author

N86-29851# Royal Aircraft Establishment, Farnborough (England). Propulsion Dept.
THE ISENTROPIC LIGHT PISTON ANNULAR CASCADE FACILITY AT RAE PYESTOCK
A. J. Brooks, D. E. Colbourne, E. T. Wedlake, T. V Jones (Oxford Univ. (England).), M. L. G. Oldfield, D. L. Schultz, and P. J. Loftus (Maryland Univ., College Park.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 23 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

An accurate assessment of heat transfer rates to turbine vanes and blades is an important aspect of efficient cooling system design and component life prediction in gas turbines. Techniques have been developed at Oxford University which permit such measurements to be obtained in test rigs which provide short duration steady flow through a turbine cascade. The temperature ratio between the gas stream and the turbine correctly models that found in an engine environment. Reynolds number and Mach numaber can be varied over a wide range to match engine conditions. The design, construction and operation of a new facility at Royal Aircraft Establishment (RAE) Pyestock, incorporating these techniques, is described. Heat transfer and aerodynamic measurements have been made on airfoil surfaces and endwalls of a fully annular cascade of nozzle guide vanes. These results are discussed and compared with those obtained from the same profile in 2-D cascade tests, and with computed 3-D flow predictions. Author

N86-29852# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
MEASUREMENTS OF FLUCTUATING GAS TEMPERATURES USING COMPENSATED FINE WIRE THERMOCOUPLES c34
M. N. R. Nina and G. P. Pita *In* AGARD Heat Transfer and Cooling in jGas Turbines Sep. 1985 10 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Thermocouples with three different wire diameters (15, 40 and 50 microns) were used in association with an analog compensation circuit connected to a data acquisition system. Measurements of the time constant were performed using two different heating techniques; Joule effect and external heating by laser beam. The thermocouples were used to quantify the fluctuating temperature field in a hot air jet and in a premixed propane flame. In the reacting case the catalytic effect was evaluated by comparing coated and uncoated wires. Conclusions were also obtained regarding frequency spectra, temperature probability distribution function and time constant. Author

N86-29853# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
TWO SPOT LASER VELOCIMETER MEASUREMENTS OF VELOCITY AND TURBULENCE INTENSITY IN SHOCK TUBE DRIVEN TURBINE FLOWS c34
Richard B. Rivir, William C. Elrod (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.), and Michael G. Dunn (Calspan Advanced Technology Center, Buffalo, N.Y.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Full-scale rotating turbine heat transfer tests are discussed. The turbine is driven by a shock tube of short duration. Heat transfer distributions are measured during the test by thin film surface gages on the various component parts. Direct measurement of the velocity and turbulence intensity is needed to accurately compute the heat transfer for comparison with the measured values. An investigation to determine if measurements of velocity and turbulence intensity could be obtained with a two-spot laser velocimeter in the turbine for these short duration shock driven flows was undertaken. Two seed materials were investigated with satisfactory results: propylene glycol and Dow 200. The velocimeter was initially set up on a low-pressure-ratio shock tube which could be cycled quickly to determine the seeding requirements. The velocimeter was transferred to the high-pressure, full-scale turbine after successful measurements in the low-pressure shock tube. Author

N86-29854# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
INFLUENCE AND TIP CLEARANCE MEASUREMENT IN TURBOMACHINES c37
Jacques Paulon *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 8 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The clearance between the tip of the blades and the casing of a turbomachine is an important parameter. The performances of an engine are strongly subject to tip clearance. These gap effects are illustrated and numbered through some examples. Then, it would be desirable to control it permanently and to adjust the temperature of the casing in order to operate in optimum conditions. To this effect, a capacitive transducer is in development at ONERA and good results have been obtained in comparison with other devices. Author

N86-29855# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
SIMULATION OF FLOW AND HEAT TRANSFER IN ANNULAR CAVITIES BETWEEN DISKS IN TURBOMACHINERY c37
Denis Dutoya *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The first developments of a numerical code for the prediction of flow and heat transfer within the annular cavities extending between the rotating and stationary disks of turbomachines are discussed. A short description of the numerical method and of the turbulence model used is presented and a few examples of calculations performed in simple flow configurations are shown: acoustics within cavities, some turbulent flows with singular heat losses, and flow calculations in shrouded disk systems with or without radial outflow. Comparison with published experimental data allows one to measure the qualities and limits of the chosen turbulent model. Author

N86-29856# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
TRANSIENT THERMAL BEHAVIOUR OF A COMPRESSOR ROTOR WITH VENTILATION: TEST RESULTS UNDER SIMULATED ENGINE CONDITIONS c34
E. Reile, U. Radons, and D. K. Hennecke *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 9 p (For primary document

see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The development of advanced compressors for modern aero-engines requires detailed knowledge of the transient thermal behavior of the rotor disks to enable accurate prediction of rotor life and, additionally, of the thermal growth of the rotor for the evaluation of tip clearances. In the quest for longer life and higher reliability of the parts as well as reduced clearances even at transient conditions, the designer has to be able to influence the thermal behavior of the rotor. A very effective way is to vent small amounts of air through the rotor cavities. The design of such a vented rotor is presented. The main emphasis is placed on a detailed description of a test rig specially built for this purpose. The testing was carried out under simulated engine conditions for a wide range of parameters. The results are compared with those obtained with a theoretical model derived from fundamental tests at the University of Sussex, where heat transfer in rotating cavities is investigated. Good agreement is observed. Some final tests were done in an engine. The results also exhibit good agreement with the rig results under simulated conditions, when the proper dimensionless parameters are considered, providing the validity of the simulation. Author

N86-29857# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
HEAT EXCHANGERS IN REGENERATIVE GAS TURBINE CYCLES c34
M. N. R. Nina and M. P. N. Aguas *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 8 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Advances in compact heat exchanger design and fabrication together with fuel cost rises continuously improve the attractability of regenerative gas turbine helicopter engines. In this study cycle parameters aiming at reduced specific fuel consumption and increased payload or mission range, have been optimized together with heat exchanger type and size. The discussion is based on a typical mission for an attack helicopter in the 900 kw power class. A range of heat exchangers is studied to define the most favorable geometry in terms of lower fuel consumption and minimum engine plus fuel weight. Heat exchanger volume, frontal area ratio and pressure drop effect on cycle efficiency are considered. Author

N86-29858# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
CERAMIC HEAT EXCHANGERS FOR GAS TURBINES OR TURBOJET ENGINES c37
Serge Boudigues and Jean Fabri *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

Heat exchangers made of steel and placed downstream of the last turbine of a turbojet engine or any gas turbine are too heavy and too cumbersome. With a heat exchanger made of silicon carbide mass, performance, volume and cost balances which greatly benefit civilian or military use can be obtained. Silicon carbide has good thermal performance and makes it possible to situate the heat exchanger between turbine stages. Both the pressure of cold and hot gases are thus increased, the heat exchange processes are amplified, the length and the diameter of the exchanger are reduced. With the density of this material being only 3.2, the overall mass of the exchanger is considerably reduced. It is also possible to shortcut part of the cold air, and thus obtain a controlling parameter. A kind of after burner effect is obtained, although a single combustor is used, and the corresponding thermodynamic process has a higher efficiency than the after burning process. Author

N86-29859# Technische Univ., Aachen (West Germany). Inst. for Jet Propulsion and Turbomachinery.
EFFECT OF FILM COOLING ON THE AERODYNAMIC PERFORMANCE OF A TURBINE CASCADE c34
O. Koellen and W. Koschel *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 16 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The aerodynamic performance of a film cooled turbine cascade for a typical design with multiple rows of cooling holes was investigated in an annular cascade rig with air at room temperature. The work was concentrated on the individual effect of the injection row position on the aerodynamic cascade losses and on the downstream flow field. For six different single row configurations the tests were conducted in a wide range of varying coolant mass flow rates and main stream Mach numbers. Typical results of these measurements are presented and discussed. Three models for the aerodynamic loss prediction based on different theoretical approaches, which are known from literature, were examined and improved. The presented two mixing layer models take into account the penetration of the injected cooling air into the main stream, whereas the third model predicts flow losses by a boundary layer calculation with film cooling air injection. Some tests with flow visualization by Schlieren photography were carried out showing the mixing effects of the injected coolant flow. Finally results of the predicted performance are compared with the experimental data. M.G.

N86-29860# Ecole Centrale de Lyon (France). Lab. de Mecanique des Fluides.
THEORY AND EXPERIMENTAL STUDY OF A 3-D JET INTRODUCED INTO THE SECONDARY FLOW OF A TURBINE INLET GUIDE VANE [ETUDE EXPERIMENTALE ET THEORIQUE DUN JET TRIDIMENSIONNEL INTRODUIT DANS LECOULEMENT SEONDAIRE DUNE GREILLE DISTRIBUTRICE DE TURBINE] c02
A. Onvani, C. Ollivier, F. Bario, and F. Leboeuf *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 18 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

The interaction effects between a jet introduced from the side wall and the 3-D secondary flow of a turbine inlet guide vane are defined. Only aerodynamical effects are studied. The trajectory, velocity and characteristic lengths of the jet are determined. The experimental work gives the measurements of pressure and velocity. The measurement of an intermittence coefficient with a hot wire allows also the definition of the trajectory and the shape of the jet. Experimental results show that the jet trajectory is weakly influenced by yaw angle of the hole for the ratio of momentum quantities used. Theoretical prediction is done with the help of an integral calculation method based on the use of continuity and Navier-Stokes equations averaged on the transverse section of the jet. The streamwise vorticity generated in the jet and predicted with a transport equation, and the introduction of a sink effect allow the computation of the induced transverse velocities. Experimental results and calculated quantities are in a good agreement. Author

N86-29861# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
AERODYNAMIC EFFECT OF COOLANT EJECTION IN THE REAR PART OF TRANSONIC ROTOR BLADES c34
F. H. Kost and A. T. Holmes (Rolls-Royce Ltd., Bristol, England) *In* AGARD Heat transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

An investigation of transonic turbine blades designed by Rolls-Royce/Bristol concerning the aerodynamic penalties of coolant flow for two alternative cooling configurations is discussed. Rolls-Royce designed a blade with a thick trailing edge where the coolant is ejected through slots in the trailing edge and a second blade with a thin trailing edge where coolant is ejected through a row of holes on the pressure side and a row of holes on the suction side. Tests were performed in a plane cascade wind tunnel. The results indicate the sensitivity of the blade performance to cooling configuration and coolant flow rate. By combining measured

data from blade surface and wake traverses it was possible to separate the various loss mechanisms. Therefore, the separate losses due to the momentum of the coolant, change of base pressure, and change of blade friction could be determined quantitatively as a function of coolant flow rate. M.G.

N86-29862# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. for Design Aerodynamics.

THE BOUNDARY LAYER BEHAVIOUR OF AN ADVANCED GAS TURBINE ROTOR BLADE UNDER THE INFLUENCE OF SIMULATED FILM COOLING c34

R. Kiock, H. Hoheisel, H. J. Dietrichs (Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).), and A. T. Holmes (Rolls-Royce Ltd., Bristol (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 19 p (For primary document see N86-29823 21-07)

Avail: NTIS HC A23/MF A01

The aerodynamic properties of highly loaded turbine blades are strongly influenced by local supersonic flow fields and cooling air ejection. The boundary layer interaction with shock waves and simulated cooling flows was examined in a cascade wind tunnel by means of boundary layer and wake traverses and pressure distribution measurements as well as by the application of Schlieren observation. Air was ejected through holes and slots at different locations of the blade contour. Special emphasis was put on magnitude and direction of the local jet velocity in case of multiple cooling operation. The characteristics of the blade without and with different cooling configurations were determined. The results show the effects of air ejection on boundary layer transition and shock configurations. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N86-29863*# Stanford Univ., Calif. Guidance and Control Lab.

THE DESIGN OF MULTIRATE DIGITAL CONTROL SYSTEMS Final Report

Martin Conrad Berg Mar. 1986 217 p

(Grant NsG-4002)

(NASA-CR-177126; NAS 1.26:177126; SU-SUDAAR-553) Avail: NTIS HC A10/MF A01 CSCL 01C

The successive loop closures synthesis method is the only method for multirate (MR) synthesis in common use. A new method for MR synthesis is introduced which requires a gradient-search solution to a constrained optimization problem. Some advantages of this method are that the control laws for all control loops are synthesized simultaneously, taking full advantage of all cross-coupling effects, and that simple, low-order compensator structures are easily accomodated. The algorithm and associated computer program for solving the constrained optimization problem are described. The successive loop closures , optimal control, and constrained optimization synthesis methods are applied to two example design problems. A series of compensator pairs are synthesized for each example problem. The succesive loop closure, optimal control, and constrained optimization synthesis methods are compared, in the context of the two design problems. Author

N86-29864*# Kansas Univ., Lawrence. Dept. of Aerospace Engineering.

AN INVESTIGATION OF EMPENNAGE BUFFETING Status Report, 15 Sep. 1985 - 15 Jan. 1986

C. Edward Lan and I. G. Lee 28 Jan. 1986 50 p

(Grant NAG2-371)

(NASA-CR-176973; NAS 1.26:176973) Avail: NTIS HC A03/MF A01 CSCL 01C

Progress in the investigation of empennage buffeting in reviewed. In summary, the following tasks were accomplished: relevant literatures was reviewed; equations for calculating structural response were formulated; root-mean-square values of root bending moment for a 65-degree rigid delta wing were calculated and compared with data; and a water-tunnel test program for an F-18 model was completed. Author

N86-29865*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.

FLIGHT DETERMINATION OF THE AERODYNAMIC STABILITY AND CONTROL CHARACTERISTICS OF THE NASA SGS 1-36 SAILPLANE IN THE CONVENTIONAL AND DEEP STALL ANGLES-OF-ATTACK OF BETWEEN -5 AND 75 DEGREES Final Report

Faramarz A. Mahdavi and Doral R. Sandlin 1 Jun. 1984 110 p (Contract NCC4-1)

(NASA-CR-176962; NAS 1.26:176962) Avail: NTIS HC A06/MF A01 CSCL 01C

The flight test procedure and the preliminary analysis of the results obtained from twenty manned flights of the SGS 1-36 in the high angles of attack Deep Stall region are discussed. A comparison of the flight determined stability and control derivatives, those of the wind tunnel, and the estimated aerodynamic data is also presented. Furthermore, deep stall dynamics response of the SGS 1-36 is discussed briefly to explain some of the unexpected flight observations. Author

N86-29866*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIENCE WITH SYNCHRONOUS AND ASYNCHRONOUS DIGITAL CONTROL SYSTEMS

Victoria A. Regenie, Claude V. Chacon, and Wilton P. Lock Aug. 1986 19 p To be Presented at the AIAA Guidance, Navigation and Control Conference, Williamsburg, Va., 18-20 Aug. 1986

(NASA-TM-88271; H-1372; NAS 1.15:88271; AIAA-86-2239-CP) Avail: NTIS HC A02/MF A01 CSCL 01C

Flight control systems have undergone a revolution since the days of simple mechanical linkages; presently the most advanced systems are full-authority, full-time digital systems controlling unstable aircraft. With the use of advanced control systems, the aerodynamic design can incorporate features that allow greater performance and fuel savings, as can be seen on the new Airbus design and advanced tactical fighter concepts. These advanced aircraft will be and are relying on the flight control system to provide the stability and handling qualities required for safe flight and to allow the pilot to control the aircraft. Various design philosophies have been proposed and followed to investigate system architectures for these advanced flight control systems. One major area of discussion is whether a multichannel digital control system should be synchronous or asynchronous. This paper addressed the flight experience at the Dryden Flight Research Facility of NASA's Ames Research Center with both synchronous and asynchronous digital flight control systems. Four different flight control systems are evaluated against criteria such as software reliability, cost increases, and schedule delays. Author

N86-29867*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.

MODEL-FOLLOWING CONTROL FOR AN OBLIQUE-WING AIRCRAFT

Gurbux S. Alag, Robert W. Kempel, Joseph W. Pahle, John J. Bresina, and Febo Bartoli Aug. 1986 13 p Presented at the AIAA Conference on Guidance and Control, Williamsburg, Va., 18-20 Aug. 1986

(NASA-TM-88269; H-1362; NAS 1.15:88269; AIAA-86-2244CP) Avail: NTIS HC A02/MF A01 CSCL 01C

A variable-skew oblique wing offers a substantial aerodynamic performance advantage for aircraft missions that require both high efficiency in subsonic flight and supersonic dash or cruise. The most obvious characteristic of the oblique-wing concept is the asymmetry associated with wing-skew angle which results in significant aerodynamic and inertial cross-coupling between the aircraft longitudinal and lateral-directional axes. A technique for

synthesizing a decoupling controller while providing the desired stability augmentation. The proposed synthesis procedure uses the concept of explicit model following. Linear quadratic optimization techniques are used to design the linear-feedback system. The effectiveness of the control laws developed in achieving the desired decoupling is illustrated for a given flight condition by application to linearized equations of motion, and also to the nonlinear equations of six degrees of freedom of motion with nonlinear aerodynamic data. Author

N86-29868*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.
EIGENSYSTEM SYNTHESIS FOR ACTIVE FLUTTER SUPPRESSION ON AN OBLIQUE-WING AIRCRAFT
Gurbux S. Alag (University of Western Michigan, Kalamazoo.), John J. Burken, and Glenn B. Gilyard Aug. 1986 9 p Presented at the AIAA Guidance, Navigation and Control Conference, Williamsburg, Va., 18-20 Aug. 1986
(NASA-TM-88275; H-1359; NAS 1.15:88275; AIAA-86-2243-CP) Avail: NTIS HC A02/MF A01 CSCL 01C

The application of the eigensystem synthesis technique to place the closed-loop eigenvalues and shape the closed-loop eigenvectors has not been practical for active flutter suppression, primarily because of the availability of only one control surface (aileron) for flutter suppression. The oblique-wing aircraft, because of its configuration, provides two independent surfaces (left and right ailerons), making the application of eigensystem synthesis practical. This paper presents the application of eigensystem synthesis using output feedback for the design of an active flutter suppression system for an oblique-wing aircraft. The results obtained are compared with those obtained by linear quadratic Gaussian techniques. Author

N86-29869# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
INTRODUCTION TO ROBUST MULTIVARIABLE CONTROL Final Report, Oct. 1983 - Sep. 1985
D. Brett Ridgely and Siva S. Banda Feb. 1986 430 p
(AD-A165891; AFWAL-TR-85-3102) Avail: NTIS HC A19/MF A01 CSCL 01/3

Linear multiple-input multiple-output (multivariable) control systems are considered. The intent of this report is to familiarize the working engineers with some of the developments in the area of robust multivariable control theory that have occurred in the past 10 years. The concepts of singular values are used to systematically develop robust control systems analysis and design techniques. The advantages and limitations of these techniques are discussed. Examples are used to illustrate the methods. Author (GRA)

N86-29870# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abt. Elastomechanik und Aeroelastische Stabilitaet
ACTIVE FLUTTER SUPPRESSION ON A DELTA WING MODEL STRUCTURE
Raymond Freymann and Kunyi Cheng Dec. 1985 72 p
(DFVLR-FB-86-01; ISSN-0171-1342; ESA-86-97455) Avail: NTIS HC A04/MF A01; DFVLR, Cologne, West Germany DM 26

Active flutter suppression systems were designed for a flexible model delta wing structure based either on the concept of fictitious structural modifications or on frequency response methods. For validation of the results from the analytical investigations, extensive tests were performed on the model delta wing structure in a 3m x 3m low speed wind tunnel. During the tests the flutter speed of the actively controlled wing was increased by 25% compared to the basic, uncontrolled system. Good agreement between calculated and measured results is found. ESA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N86-29871*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADAPTIVE WALL WIND TUNNELS: A SELECTED, ANNOTATED BIBLIOGRAPHY
Marie H. Tuttle (Vigyan Research Associates, Inc., Hampton, Va.) and Raymond E. Mineck Aug. 1986 55 p
(NASA-TM-87639; L-16084; NAS 1.15:87639) Avail: NTIS HC A04/MF A01 CSCL 14B

This bibliography, with abstracts, consists of 257 citations arranged in chronological order. Selection of the citations was made for their value to researchers working to solve problems associated with reducing wall interference by the design, development, and operation of adaptive wall test sections. Author, source, and subject indexes are included. Author

N86-29872*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CRYOGENIC WIND TUNNELS FOR HIGH REYNOLDS NUMBER TESTING
Pierce L. Lawing, Robert A. Kilgore, and Peggy D. McGuire May 1986 95 p
(NASA-TM-87743; NAS 1.15:87743) Avail: NTIS HC A05/MF A01 CSCL 14B

A compilation of lectures presented at various Universities over a span of several years is discussed. A central theme of these lectures has been to present the research facility in terms of the service it provides to, and its potential effect on, the entire community, rather than just the research community. This theme is preserved in this paper which deals with the cryogenic transonic wind tunnels at Langley Research Center. Transonic aerodynamics is a focus both because of its crucial role in determining the success of aeronautical systems and because cryogenic wind tunnels are especially applicable to the transonics problem. The paper also provides historical perspective and technical background for cryogenic tunnels, culminating in a brief review of cryogenic wind tunnel projects around the world. An appendix is included to provide up to date information on testing techniques that have been developed for the cryogenic tunnels at Langley Research Center. In order to be as inclusive and as current as possible, the appendix is less formal than the main body of the paper. It is anticipated that this paper will be of particular value to the technical layman who is inquisitive as to the value of, and need for, cryogenic tunnels. Author

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N86-29873*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MANNED MARS MISSIONS: A WORKING GROUP REPORT Summary Report
Michael B. Duke, ed. and Paul W. Keaton (Los Alamos National Lab., N. Mex.) May 1986 86 p Working Papers presented at Marshall Space Flight Center, Huntsville, Ala., 10-14 Jun. 1985
(NASA-TM-88777; NASA-M001; NAS 1.15:88777) Avail: NTIS HC A05/MF A01 CSCL 22A

The findings and conclusions of the Manned Mars Mission Working Group are summarized. The following issues are individually discussed: scientific objectives of Mars missions, Mars

surface activities, mission concepts, transportation trades and options, space vehicle and subsystems design, life science and life support issues, impacts on the space infrastructure, and cost and schedules. M.G.

N86-29874# Lawrence Livermore National Lab., Calif.
TOWARD A PERMANENT LUNAR SETTLEMENT IN THE COMING DECADE: THE COLUMBUS PROJECT
R. A. Hyde, M. Y. Ishikawa, and L. L. Wood 19 Nov. 1985 28 p Presented at the US Space Foundation Symposium, Colorado Springs, Colo., 20 Nov.1985
(Contract W-7405-eng-48)
(DE86-006709; UCRL-93621; CONF-8511155-1) Avail: NTIS HC A03/MF A01

The motivation for creating a permanent lunar settlement is sketched, and reasons for doing so in the coming decade are put forward. A basic plan to accomplish this is outlined, along technical and programmatic axes. It is concluded that founding a lunar settlement on the five hundredth anniversary of the Columbus landing - a Columbus Project - could be executed as a volunteer-intensive American enterprise requiring roughly six thousand man-years of skilled endeavor and a total Governmental contribution of the order of a half-billion dollars. DOE

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N86-29875# National Oceanic and Atmospheric Administration, Washington, D. C. Systems Design and Applications Branch.
A DESCRIPTION OF PREDICTION ERRORS ASSOCIATED WITH THE T-BUS-4 NAVIGATION MESSAGE AND A CORRECTIVE PROCEDURE
Frederick W. Nagle Jul. 1986 33 p
(NOAA-TM-NESDIS-16) Avail: NTIS HC A03/MF A01

The instantaneous positions of the NOAA-x orbiting satellites predicted by means of the T-Bus orbital parameters have been subject to considerable error. The nature of this error is described , and although its precise cause is unknown, it appears possible to introduce corrections which greatly reduce it. The correcting algorithm makes use of the fact that the Equator-to-Equator orbital period of a NOAA-x satellite is highly predictable, and this periodicity can be employed to stabilize the predicted positions by adjusting the along-track predictions to correspond to the known times of Equator crossing. Author

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N86-29876*# National Aeronautics and Space Administration, Washington, D.C.
AN OVERVIEW OF THE KALININGRAD SPACEFLIGHT CONTROL CENTER
May 1986 35 p Transl. into ENGLISH of the mono. "Tsentr Upravleniya Poletom" Moscow, USSR, Mashinostroyeniye, 1985 p 1-33 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASw-4006)
(NASA-TM-87980; NAS 1.15:87980) Avail: NTIS HC A03/MF A01 CSCL 14B

A general description is given of the Kaliningrad Spaceflight Center near Moscow, where Soviet orbiting and interplanetary spacecraft are monitored and controlled. Brief descriptions of the equipment used and the scope of work done at the center are included. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N86-29877*# Martin Marietta Aerospace, Denver, Colo.
NEAR-FIELD TESTING OF THE 15-METER MODEL OF THE HOOP COLUMN ANTENNA. VOLUME 2: NEAR- AND FAR-FIELD PLOTS FOR THE LaRC FEEDS
John Hoover, Neill Kefauver, Tom Cencich, and Jim Osborn Mar. 1986 282 p
(Contract NAS1-18016)
(NASA-CR-178060; NAS 1.26:178060; MCR-85-640-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 22B

The technical results from near-field testing of the 15-meter model of the hoop column antenna at the Martin Marietta Denver Aerospace facility are described. The antenna consists of a deployable central column and a 15-meter hoop, stiffened by cable into a structure with a high tolerance repeatable surface and offset feed location. The surface has been configured to have four offset parabolic apertures, each about 6 meters in diameter, and is made of gold plated molybdenum wire mesh. Pattern measurements were made with feed systems radiating at frequencies of 7.73, 11.60, 2.27, 2.225, and 4.26 (all in GHz). This report (Volume II) gives the detailed patterns measured with the LaRC feeds (7.73, 11.60, 2.27, and 4.26 GHz). Volume I covers the testing from an overall viewpoint and contains information of generalized interest for testing large antennas, including the deployment of the antenna in the Martin Facility and the measurements to determine mechanical stability and trueness of the reflector surface, the test program outline, and a synopsis of antenna electromagnetic performance. A detailed listing of the antenna patterns are provided for the 2.225 Ghz feed in Volume III of this report. Author

N86-29878# Army Armament Research and Development Command, Dover, N. J. Armament Engineering Directorate.
COMPUTER SIMULATION OF ROCKET/MISSILE SAFING AND ARMING MECHANISM (CONTAINING PIN PALLET RUNAWAY ESCAPEMENT, THREE-PASS INVOLUTE GEAR TRAIN AND ACCELERATION DRIVEN ROTOR) Final Technical Report, Jan. 1983 - May 1985
P. T. Gorman and F. R. Tepper Mar. 1986 135 p
(AD-A166667; AD-E401472; ARAED-TR-85010) Avail: NTIS HC A07/MF A01 CSCL 19/1

A complete simulation of missile and rocket safing and arming (S&A) mechanisms containing an acceleration-driven rotor, a three-pass involute gear train, and a pin pallet runaway escapement was developed. In addition, a modification to this simulation was formulated for the special case of the PATRIOT M143 S&A mechanism which has a pair of driving gears in addition to the three-pass gear train. The three motion regimes involved in escapement operation - coupled motion, free motion, and impact - are considered in the computer simulation. The simulation determines both the arming time of the device and the non-impact contact forces of all interacting components. The program permits parametric studies to be made, and is capable of analyzing pallets with arbitrarily located centers of mass. A sample simulation of the PATRIOT M143 S&A in an 11.9 g constant acceleration arming test was run. The results were in good agreement with laboratory test data. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N86-29879*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AEROSPACE SAFETY ADVISORY PANEL REPORT TO THE NASA ACTING ADMINISTRATOR Annual Report, Calendar Year 1985
Jan. 1986 118 p The Panel's annual report, findings and recommendations were completed prior to the STS-51L accident
(NASA-TM-89226; NAS 1.15:89226) Avail: NTIS HC A06/MF A01 CSCL 22B

The level of activity of the Aerospace Safety Advisory Panel was increased smewhat during 1985 in concert with the increased mission rate of the National Space Transportation System, the evolutionary changes in management and operation of that program, and the preparation of the Vandenberg Launch Site; the implementation of the Program Definition Phase of the Space Station Program; and the actual flight testing of the X-29 research aircraft. Impending payload STS missions and NASA's overall aircraft operations are reviewed. The safety aspects of the LEASAT salvage mission were assessed. The findings and recommendation of the committee are summerized. Author

N86-29880# Air Force Geophysics Lab., Hanscom AFB, Mass.
SHUTTLE CONTAMINATION MODELING: THE PLASMA WAVE FIELD OF SPACECRAFT
Michael Heinemann 22 Nov. 1985 43 p
(AD-A166605; AFGL-TR-85-0300; AFGL-ERP-936) Avail: NTIS HC A03/MF A01 CSCL 22/1

We investigate the behavior of waves and shock-like disturbances produced by the interaction of spacecraft with the plasma environment. We find that (1) there are three ranges of wave frequency for which waves can propagate to large distances from the spacecraft, (2) that waves in these frequency ranges are confined to propagate within specific ranges of directions, and (3) that it is possible for these waves to form shocks. Approximate analytic solutions are given to describe the behavior of waves and shocks of spacecraft origin. The waves that are important to these phenomena can be classed as Alfven, whistler, and upper hybrid waves. While we believe it unlikely to occur, we have identified analytically those conditions necessary for extremely rapid spatial wave growth near the spacecraft. GRA

N86-29881# Mound Lab., Miamisburg, Ohio.
CRYOGENIC EXPLOSION ENVIRONMENT MODELING AND TESTING OF SPACE SHUTTLE AND LIGHT-WEIGHT RADIOISOTOPE HEATER UNIT INTERACTIONS
E. W. Johnson Oct. 1985 27 p
(Contract DE-AC04-76DP-00053)
(DE86-005901; MLM-3303) Avail: NTIS HC A03/MF A01

In order to assess the risk to the world's populace in the event of a Space Shuttle accident when radioisotope-containing heat sources are on board, testing of that system must be performed to determine release point, environments required, and the size distribution of the released fuel. To evaluate the performance of the Light-Weight Radioisotope Heater Unit (LWRHU) (101 of these 1-W items are placed on the Galileo spacecraft which will be launched from the Space Shuttle), some high-velocity impact and flyer plate testing was carried out. The results showed that a bare urania-fueled LWRHU clad (approximately 1-mm thick platinum-30 wt % rhodium alloy) will withstand 1100 m/s flyer plate (3.5-mm thick aluminum) impacts and 330 m/s impacts upon the Space Shuttle floor (approximately 12-mm thick aluminum) without rupture or fuel release. Velocities in the order of 600 m/s on a steel surface will cause clad failure with fuel release. The fuel breakup patterns were characterized as to quantity in a specific size range. These data were employed in the formal Safety Analysis Report for the LWRHU to support the planned 1986 Galileo launch. LWRHU to support the planned 1986 Galileo launch. DOE

N86-29882# Joint Publications Research Service, Arlington, Va.
WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY
4 Apr. 1986 62 p Transl. into ENGLISH from various West European articles
(JPRS-WST-86-016) Avail: NTIS HC A04/MF A01

Topics addressed include: advanced materials; aerospace industry; automobile industry; civil aviation; computers; scientific and industrial policy; metallurgical industry; and microelectronics. For individual titles, see N86-29883 through N86-29883.

N86-29883# Joint Publications Research Service, Arlington, Va.
DIFFERENCES BETWEEN HERMES, US SHUTTLE HIGHLIGHTED
In its West Europe Report: Science and Technology (JPRS-WST-86-016) 4 Apr. 1986 p 8-9 Transl. into ENGLISH from Die Weltwoche (Zuerich, West Germany), 6 Feb. 1986 p 29 (For primary document see N86-29882 21-16)
Avail: NTIS HC A04/MF A01

In response to French urging, the European Space Agency (ESA) decided to regularly upgrade the Ariane Launch Vehicle. Ariane-5 will be able to launch a payload of 15 tons into an orbit 400 km high, and transport 5 tons into a geostationary orbit 36,000 km above the earth's surface. At least 7.5 billion DM will be needed to finance the Hermes, which can be launch by the Ariane-5. The versatility of the Hermes is discussed. The impact of the Challenger explosion on building of the Hermes is examined The differences between the two space shuttles is also discussed. B.G.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

N86-29884*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.
A RADAR DATA PROCESSING AND ENHANCEMENT SYSTEM
Karl F. Anderson, John W. Wrin, and Robert James (GMD Systems, Lancaster, Calif.) 1986 19 p Presented at the IRIG Electronic Trajectory Measurements Group Meeting, El Paso, Tex., 6 Aug. 1986
(NASA-TM-88274; H-1377; NAS 1.15:88274) Avail: NTIS HC A02/MF A01 CSCL 09F

This report describes the space position data processing system of the NASA Western Aeronautical Test Range. The system is installed at the Dryden Flight Research Facility of NASA Ames Research Center. This operational radar data system (RADATS) provides simultaneous data processing for multiple data inputs and tracking and antenna pointing outputs while performing real-time monitoring, control, and data enhancement functions. Experience in support of the space shuttle and aeronautical flight research missions is described, as well as the automated calibration and configuration functions of the system. Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-29885*# National Aeronautics and Space Administration, Washington, D.C.

THE ELECTRIFICATION OF SPACECRAFT
A. I. Akishin and L. S. Novikov Jul. 1985 75 p Transl. into ENGLISH of the book "Elektrizatsiya Kosmicheskikh Apparatov" Znaniye Press, Moscow, USSR, 1985 p 1-61 Transl. by SCITRAN, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-77653; NAS 1.15:77653) Avail: NTIS HC A04/MF A01 CSCL 22B

Physical and applied aspects of the electrification of space vehicles and natural celestial objects are discussed, the factors resulting in electrification of spacecraft are analyzed, and methods of investigating various phenomena associated with this electrification and ways of protecting spacecraft against the influence of static electricity are described. The booklet is intended for the general reader interested in present day questions of space technology. Author

N86-29886*# Massachusetts Inst. of Tech., Cambridge. Space Systems Lab.
STUDY OF ONBOARD EXPERT SYSTEMS TO AUGMENT SPACE SHUTTLE AND SPACE STATION AUTONOMY Final Report, 1 Aug. 1984 - 31 Dec. 1985
Clifford R. Kurtzman, David L. Akin, David Kranzler, and Edith Erlanson 31 Jul. 1986 91 p
(Grant NAG5-445)
(NASA-CR-176958; NAS 1.26:176958; SSL-16-86) Avail: NTIS HC A05/MF A01 CSCL 22B

The feasibility of onboard crew activity planning was examined. The use of expert systems technology to aid crewmembers in locating stowed equipment was also investigated. The crew activity planning problem, along with a summary of past and current research efforts, was discussed in detail. The requirements and specifications used to develop the crew activity planning system was also defined. The guidelines used to create, develop, and operate the MFIVE Crew Scheduler and Logistics Clerk were discussed. Also discussed is the mathematical algorithm, used by the MFIVE Scheduler, which was developed to aid in optimal crew activity planning. B.G.

N86-29887# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A SELF-TUNING REGULATOR BASED ON POLE PLACEMENT DESIGN FOR USE IN SATELLITE ATTITUDE CONTROL
Jose Francisco Ribeiro, Antonio Felix Martins Neto, and Joao Moro Apr. 1986 19 p Submitted for publication
(INPE-3861-PRE/924) Avail: NTIS HC A02/MF A01

The problem of controlling a three axis stabilized satellite is approached by using self tuning pole assignment techniques. Considering the requirements of the Brazilian Remote Sensing satellite, a controller is designed and its performance is analyzed by using digital simulation for similar satellite dynamics. This simulation considers a 500 km altitude satellite with almost polar orbit, subjected to environmental disturbances (gravity gradient, aerodynamical torques, solar radiation, etc), and provided with a set of on board sensors (Earth sensor, sun sensor and gyrometers). Author

N86-29888*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
PROCEEDINGS OF THE 2ND ANNUAL CONFERENCE ON NASA/UNIVERSITY ADVANCED SPACE DESIGN PROGRAM
Jun. 1986 31 p Conference held at Cocoa Beach, Fla., 18-20 Jun. 1986
(Grant NGT21-002-080)
(NASA-TM-89399; NAS 1.15:89399) Avail: NTIS HC A03/MF A01 CSCL 22B

Topics discussed include: lunar transportation system, Mars rover, lunar fiberglass production, geosynchronous space stations, regenerative system for growing plants, lunar mining devices, lunar oxygen transporation system, mobile remote manipulator system, Mars exploration, launch/landing facility for a lunar base, and multi-megawatt nuclear power system. B.G.

N86-29889*# National Aeronautics and Space Administration, Washington, D.C.
X-RAY SATELLITE (ROSAT) Status Report, 1985
Apr. 1986 54 p Transl. into ENGLISH OF "Roentgensatellit Statusbericht; 4. Quartal 1985" Porz-Wahn (West Germany), 1 Dec. 1985 p 1-68 Transl. by Scitran, Inc., Santa Barbara, Calif. Original document was prepared by DFVLR
(Contract NASw-4004)
(NASA-TM-88481; NAS 1.15:88481; SR-4; DFVLR-RF-TN-4) Avail: NTIS HC A04/MF A01 CSCL 22B

An overview of the current status of the ROSAT X-Ray satellite project is given. Areas discussed include an overview of problem areas, systems and mechanical subsystems, the electrical subsystem, power supply, data processing and transmission, the wide field camera, ground support equipment and the production scheduling. It is shown that the project is proceeding according to schedule, including the hardware production and costs. However, it is stated that estimated additional costs will exceed the plan. The previous schedule for production of the flight model will no longer be met. A modified milestone plan has been worked out with Dornier Systems. The current working schedule calls for a launch data of December 21, 1987; however, this does not take into account a 4-week buffer prior to transporting the flight model to the launch site. As of the date of this report, milestone M5 has been met. Previous problems with the gold vapor deposition on the flight model mirror due to contamination have been eliminated. Author

N86-29890# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
ACOSS ELEVEN (ACTIVE CONTROL OF SPACE STRUCTURES) S Final Report, Oct. 1983 - Jul. 1984
D. R. Hegg, G. J. Kissel, N. H. McClamroch, M. J. Villalba, and I. G. Rosen Sep. 1985 286 p
(Contracts F30602-81-C-0180; ARPA Order 3655; AF Proj. C65-5)
(AD-A165864; CSDL-R-1721; RADC-TR-85-165) Avail: NTIS HC A13/MF A01 CSCL 15/4

The main lines of effort in flexible structure control have been: (1)synthesis of reduced order control for vibration suppression; (2)system identification, with special attention to the resolution of closely spaced modes; and (3)generation of smooth large angle slew control. Highlights of current results are as follows. A final account is given of insights obtained during a systematic investigation of mutual interactions within the overall active control systhesis process between reduced order modeling, actuator and sensor selection, and controller feedback strategy determination. Using linear multivariate loop transfer recovery, full order stability robustness to unmodeled high frequency dynamics in the presence of wideband disturbances is demonstrated on ACOSS model no. 2. A perspective on electromechanical actuator dynamics modeling is presented. Interface constraints with the controller synthesis process associated with the use of high resolution spectrum estimation for reduced order modeling are analyzed. Parametric use of the data sampling period to assist in the resolution of closely spaced modes is discussed or demonstrated. An improved technique for parameter estimation in distributed parameter systems is generated. Author

N86-29891# Massachusetts Inst. of Tech., Cambridge.
WAVE PROPAGATION MEASUREMENTS ON TWO-DIMENSIONAL LATTICE Technical Report, 1 Feb. - 15 Sep. 1985
James H. Williams, Jr., Jia J. Zhang, and Samson S. Lee 15 Sep. 1985 32 p
(Contract F49620-83-C-0092)
(AD-A166207; AFOSR-86-0095TR) Avail: NTIS HC A03/MF A01 CSCL 22/2

Wave propagation characteristics of large space structures (LSS) affect their performance, integrity and the ability to nondestructively assess their integrity. In this study, wave propagation characteristics of a periodic lattice structure are determined

experimentally. The structure considered is an aluminum multi-bay planar lattice. Two ultrasonic piezoceramic longitudinal transducers are mounted at various locations on the structure. Wave measurements are obtained by injecting an impulsive load via the transmitting transducer and recording the response via the receiving transducer. The waves injected into the structure are longitudinal waves, transverse to the surface, although a complex stress distribution which may be described by directivity functions is actually realized. The impulsive loading signal has a broad frequency spectrum containing frequencies greater than 0.5 MHz. This preliminary experimental study demonstrates that wave propagation characteristics of a lattice structure can be obtained. In particular, the wave speed, the frequency at the maximum amplitude of the output spectrum, and the attenuation of the maximum amplitude of the output spectrum per lattice bay traversed appear to be useful parameters in the characterization of wave propagation properties of LSS. Further study should investigate the effects of boundaries, lattice member connectivities, and structural defects on these parameters. GRA

N86-29892# Massachusetts Inst. of Tech., Cambridge.
FAILURE PROPAGATION IN CONTINUUM MODELS OF LSS (LARGE SPACE STRUCTURES), PART 1 Technical Report, 1 Sep. - 1 Nov. 1985
James H. Williams, Jr. and Samson S. Lee 1 Nov. 1985 30 p
(Contract F49620-85-C-0148)
(AD-A166208; AFOSR-86-0094TR-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 13/13

Large space structures (LSS) can often be modelled adequately as equivalent anisotropic continua. In this study concepts in failure mechanics and wave propagation are applied to analyze the dynamic failure (fracture, buckling, joint disassembly, etc.) and failure arrest behavior of such an equivalent continuum. For simplicity, the equivalent continuum is assumed to be orthotropic. Furthermore, the transverse shear deformation of the equivalent continuum is assumed to dominate. Double cantilever beam models are well established fracture mechanics models in the study of crack propagation in a continuum. An orthotropic double cantilever shear beam (DCSB) model is adopted here to study Mode I dynamic failure (which for convenience is assumed to be fracture) and arrest in continuum models of lattice structures. The orthotropic DCSB model consists of both a primary material and a finite width arrester section. The DCSB model has predicted that under the proper conditions the crack may arrest when any of the following conditions is satisfied: 1) When the initial reflected disturbance catches the crack tip, before the crack tip reaches the arrester section; 2) When the crack tip enters the arrester section; 3) When the crack tip exits the arrester section; or 4) When the initial reflected disturbance catches the crack tip, after the crack tip has exited from the arrester section. It is shown that condition (1) is absolute, meaning that the crack is always arrested. GRA

N86-29893# Toronto Univ. (Ontario). Dept. of Electrical Engineering.
CHARGE ACCUMULATION AND ARC DISCHARGES ON SPACECRAFT MATERIALS AND COMPONENTS Final Report, 1 Sep. 1984 - 31 Aug. 1985
K. G. Balmain 11 Nov. 1985 62 p
(Grant AF-AFOSR-0342-84)
(AD-A166216; AFOSR-86-0057TR) Avail: NTIS HC A04/MF A01 CSCL 22/2

A study of arc discharge strength was carried out, emphasizing its variation with the thickness of the dielectric-sheet specimens which had been exposed to an incident 20 keV electron beam at a current density of a thickness at which the peak current and the energy released into a load resistor are maximized. The addition of a low-energy ion beam was found to reduce discharge strength without significantly altering thickness-scaling. Also, experimental evidence was presented for a new effect called the ion spot phenomenon in which the incident ions are focussed into a central spot which then glows due to electron-impact luminescence. The first stage in the analysis of the ion spot phenomenon has been carried out and is described in this report. A two-dimensional analysis reveals complex ion trajectories which produce not only a strip (equivalent to a spot) of ion deposition, but are also such as to produce a spot with very sharply defined edges, just as observed experimentally. As for the spacecraft-charging experimental facility, a chamber capable of holding specimens up to 30 cm diameter has been completed. Arc discharges of 700 A peak have been recorded for the largest specimens and a system for making surface potential measurements has been tested. GRA

N86-29894# Hughes Research Labs., Malibu, Calif.
POSITIVE ION EJECTION SYSTEM (PIES) Final Report, 14 Mar. 1983 - 30 Apr. 1985
R. Robson, W. Williamson, and J. Hyman Sep. 1985 75 p
(Contract F19628-83-C-0057)
(AD-A166560; AFGL-TR-85-0251) Avail: NTIS HC A04/MF A01 CSCL 20/3

The Contractor has designed, fabricated, tested, and delivered both a breadboard- and a flight-model Positive Ion Ejection System (PIES). The flight-model system will be employed to eject positive charge from a rocket (BERT I) in order to simulate and investigate spacecraft charging. The PIES models each consist of an argon-ion source; an argon expellant tank; power, command, and telemetry electronics; and suitable packaging. The ion source emits an unneutralized argon-ion beam at selected voltages in the energy range from 0.5 to 4.5 keV, with selected ion-beam currents in the range of 0.02 to 20 mA. The flight-model PIES exhibits environmental-tolerance attributes suitable for rocket launch. Design considerations, final design configuration, and test data are presented. GRA

N86-29895# Air Force Geophysics Lab., Hanscom AFB, Mass.
SPACECRAFT SHEATH MODIFICATION DURING BEAM EJECTION
Shu T. Lai, Herbert A. Cohen, and William J. McNeil 11 Sep. 1985 20 p Presented at the International School for Space Simulations, Kauai, Hawaii, 3-16 Feb. 1985
(AD-A166604; AFGL-TR-85-0215; AFGL-ERP-929) Avail: NTIS HC A02/MF A01 CSCL 22/1

Numerical solutions to the equations relating the charge ejection to spacecraft potential have been used to study the response of spacecraft potential to ion and electron beam emissions. Ionization occurs within the sheath due to the return current. The charge density and potential profile in the sheath are altered. Non-monotonic behavior of spacecraft potential as a function of beam current is obtained. Parametric studies on the effects of neutral density, electron temperature, mean free path, and spacecraft size have been performed. Experimental evidence of spacecraft sheath modification during beam ejections is discussed. GRA

N86-29896# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A COMPREHENSIVE ANALYSIS ALGORITHM FOR ABLATION, TEMPERATURE FIELDS AND THERMAL STRESSES OF THE CARBON-BASE NOSETIPS
Zhen Zhong Huang 24 Feb. 1986 24 p Transl. into ENGLISH from Yuhang Xuebao (China), no. 7, 1984 p 30-38
(AD-A166615; FTD-ID(RS)T-0746-85) Avail: NTIS HC A02/MF A01 CSCL 22/2

The principles of the synthetic analysis and treatment techniques concerning vehicle re-entry thermal environment, ablation, heat transfer and thermal stresses are described. The thermochemical ablation calculations for chemical reactions on the ablating surfaces of carbon-base materials are simplified using selective calculation results. The temperature fields are calculated using the three-level explicit difference schemes for both constant and non-constant space steps within the total region. The thermal stresses are calculated, based on the incomplete generalized potential energy variational principles under the supposed conditions of linear elasticity, using the finite element method. This method can also be usd to calculate the effects of the various displacement boundary conditions. An automatic grid generation technique has been developed during the computer code editing, which helps improve the shape selection calculations. GRA

N86-29897# Joint Publications Research Service, Arlington, Va.
WORLDWIDE REPORT: TELECOMMUNICATIONS POLICY, RESEARCH, AND DEVELOPMENT
13 May 1986 39 p Transl. into ENGLISH from various worldwide articles
(JPRS-TTP-86-013) Avail: NTIS HC A04/MF A01

Telecommunication topics addressed include: telephone switching systems, computer automation, satellites, Telecom Network, technology transfer, Bigfon Network, Aerospatiale satellite construction, and fiber optics. For individual titles, see N86-29898 through N86-29898.

N86-29898# Joint Publications Research Service, Arlington, Va.
SATELLITES SAID TO FUNCTION WELL, PLANS REVEALED *In its* Worldwide Report: Telecommunications Policy, Research, and Development (JPRS-TTP-86-013) 13 May 1986 p 16-17 Transl. into ENGLISH from the Times of India (Bombay, India), 7 Apr. 1986 p 12 (For primary document see N86-29897 21-18)
Avail: NTIS HC A03/MF A01

The fabrication of INSAT-1C (Indian National Satellite 1-C) is nearing completion and the acceptance test for the satellite would be conducted in April, 1986. The lauching of the satellite was delayed due to the recent setback in the U. S. space shuttle program. The current status of the satellite program was reviewed. B.G.

N86-30589*# Northwestern Univ., Evanston, Ill. Astronomical Research Center.
THE USE OF TETHERED SATELLITES FOR THE COLLECTION OF COSMIC DUST AND THE SAMPLING OF MAN MADE ORBITAL DEBRIS FAR FROM THE SPACE STATION
G. J. Corso *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 52-53 refs Prepared in cooperation with Loyola Univ., Chicago, Ill. (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30595*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
EFFECTS OF THE LOW EARTH ORBITAL ENVIRONMENT ON SPACECRAFT MATERIALS Abstract Only
Lubert J. Leger *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 67 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30598*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
THE SOLAR MAXIMUM SATELLITE CAPTURE CELL: IMPACT FEATURES AND ORBITAL DEBRIS AND MICROMETEORITIC PROJECTILE MATERIALS
D. S. McKay, F. J. M. Rietmeijer (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.), L. S. Schramm, R. A. Barrett, H. A. Zook, and G. E. Blanford (Houston Univ., Clear Lake, Tex.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 72-75 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30599*# National Aeronautics and Space Administration, Washington, D.C.
DUST COLLECTION ON SERVICEABLE SATELLITES
Joseph A. Nuth, III *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 76 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30602*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE STATION
David R. Thompson *In* Lunar and Planetary Inst. IN Trajectory Determination and Collection of Micrometeoroids on the Space Station 1986 p 83-84 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N86-29899# MATRA Espace, Toulouse (France). Div. Instrumentation.
IMAGING AND SOUNDING INSTRUMENTS IN THE SPIN STABILIZED VERSION OF THE SECOND GENERATION METEOSAT Final Report [METEOSAT, DEUXIEME GENERATION. ETUDE DES INSTRUMENTS IMAGEUR ET SONDEUR EN VERSION SATELLITE SPINNE]
A. Peraldi, P. Hollier, G. Eichen, B. Laurent, and V. Poinsignon Paris ESA 25 Jul. 1985 86 p In FRENCH
(Contract ESA-6163/85-F-RD(S))
(Rept-60/1568; ESA-CR(P)-2172; ESA-86-97218) Avail: NTIS HC A05/MF A01

The preliminary study of Meteosat imaging and sounding instruments is presented. The analysis shows to what extent it is possible to develop the design of the actual radiometer including the improving of the telescope, the passive radiator, image fixing, focus adjustment, and scanning modes. The solutions presented allow an improved performance without using unproved technologies. The concepts include combining both instruments with a single telescope or to design them separately. ESA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-29900*# Rockwell International Corp., Canoga Park, Calif. Rocketdyne Div.
FAILURE CONTROL TECHNIQUES FOR THE SSME, PHASE 1 Final Report
T. C. Evatt 1986 161 p
(Contract NAS8-36305)
(NASA-CR-178845; NAS 1.26:178845; RI/RD86-165) Avail: NTIS HC A08/MF A01 CSCL 21H

A failure data base and current test stand configurations were reviewed to develop requirements for a computer that analyzes the Space Shuttle Main Engine (SSME) test parameters to sense oncoming engine failurs. The minimum number of reliable indicators for use in the failure detection algorithm based on the sensor reliability and repeatability of the sensors will be selected to detect particular incidence types. The majority of the effort is anticipated in the selection of the failure to be simulated along with development and test of the failure algorithm to anchor system level requirement. B.G.

N86-29901*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
OXIDIZER HEAT EXCHANGER COMPONENT TESTING Final Report
T. Kmiec and P. Kanic Aug. 1986 60 p
(Contract NAS3-24238)
(NASA-CR-179487; NAS 1.26:179487; P/W/GPD-FR-19134-3)
Avail: NTIS HC A04/MF A01 CSCL 21H

As part of the RL10 Rocket Engine Product Improvement Program, Oxidizer Heat Exchanger (OHE) stages 1, 2, and 3 were designed and fabricated during late 1983 and early 1984. The purpose of the OHE is to provide gaseous oxygen to the pro-

pellant injector for stable engine operation at tank head idle and pumped idle operating modes. This report summarizes the OHE stages 1 and 3 rig testing, and includes the separation of the stage 1-and-2 assembly and the remanifolding of stage 1. The OHE performance analysis and analytical model modifications for both stages are also presented. The flow tests were accomplished during the time period from 9 October 1984 to 12 November 1984. Author

N86-29902# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FIREWORKS IN SPACE
21 Feb. 1986 7 p Transl. into ENGLISH from Hangkong Zhishi (China), no. 2, Feb. 1985 p 17-18
(AD-A166268; FTD-ID(RS)T-0863-85) Avail: NTIS HC A02/MF A01 CSCL 21/8

Inspired by fireworks, our ancestors invented rockets. The ignition of rockets (including the carrier rocket which is responsible for carrying a satellite into space) is conducted by a special starting device. The operating principle is to light with electricity the propellant of the engine in a rocket, putting the engine in a working condition so as to product thrust, and push it into space. At the order for ignition from a commander, the multistage rocket which carries a communication satellite starts soaring up into the sky, the whole Earth being shaken. GRA

N86-30585*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AN IN-SITU MEASUREMENT OF PARTICULATES FROM SOLID ROCKET MOTORS FIRED IN SPACE
John W. Alred *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 43-44 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N86-29903# Groningen Rijksuniversiteit (Netherlands). Materials Science Center.
[ACTIVITIES REPORT OF THE MATERIALS SCIENCE CENTER] Annual Report, 1984
May 1985 141 p
(ESA-86-97388) Avail: NTIS HC A07/MF A01

Trends in materials science, and research in solid state physics; applied physics; nuclear accelerator physics; inorganic chemistry; chemical physics; physical chemistry; and polymer chemistry are discussed. ESA

N86-29904# Groningen Rijksuniversiteit (Netherlands). Materials Science Center.
[ACTIVITIES REPORT OF THE MATERIALS SCIENCE CENTER] Annual Report, 1983
May 1984 146 p
(ESA-86-97389) Avail: NTIS HC A07/MF A01

Trends in materials science, and research in solid state physics; applied physics; nuclear accelerator physics; inorganic chemistry; chemical physics; physical chemistry; and polymer chemistry are discussed. ESA

24 COMPOSITE MATERIALS

Includes laminates.

N86-29905*# California Univ., Davis. Div. of Textiles and Clothing.
DIFFERENCES IN INTERFACIAL BOND STRENGTHS OF GRAPHITE FIBER-EPOXY RESIN COMPOSITES Final Report
Howard L. Needles 1985 26 p
(Contract NCC2-264)
(NASA-CR-176912; NAS 1.26:176912) Avail: NTIS HC A03/MF A01 CSCL 11D

The effect of epoxy-size and degree of cure on the interfacial bonding of an epoxy-amine-graphite fiber composite system is examined. The role of the fiber-resin interface in determining the overall mechanical properties of composites is poorly understood. A good interfacial adhesive bond is required to achieve maximum stress transfer to the fibers in composites, but at the same time some form of energy absorbing interfacial interaction is needed to achieve high fracture toughening. The incompatibility of these two processes makes it important to understand the nature and basic factors involved at the fiber-resin interface as stress is applied. The mechanical properties including interlaminar shear values for graphite fiber-resin composites are low compared to glass and boron-resin composites. These differences have been attributed to poor fiber-matrix adhesion. Graphite fibers are commonly subjected to post-treatments including application of organic sizing in order to improve their compatibility with the resin matrix and to protect the fiber tow from damage during processing and lay-up. In such processes, sized graphite fiber tow is impregnated with epoxy resin and then layed-up i nto the appropriate configuration. Following an extended ambient temperature cure, the graphite-resin composite structure is cured at elevated temperature using a programmed temperature sequence to cure and then cool the product. Author

N86-29906# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
A MODIFIED MICROBONDING TEST FOR DIRECT IN-SITU FIBER/MATRIX BOND STRENGTH DETERMINATION IN FIBER COMPOSITES
J. F. Mandell, D. H. Grande, T.-H. Tsiang, and F. J. McGarry Dec. 1984 48 p Sponsored in part by Owens Corning Fiberglass Corp.
(Contract DAAG46-77-C-0070)
(MIT-RR-R84-3) Avail: NTIS HC A03/MF A01

A test method for determining the in-situ fiber/matrix bond strength of composites is described. In a sequence of steps a compressive load is applied to individual fibers oriented normal to a polished surface, and the interface is observed microscopically between loading steps, until debonding occurs. The direct result of a test is the force to produce debonding of a particualr fiber. The data are reduced to a nominal interfacial shear strength through a finite element analysis using a simplified model of the fiber, surrounding matrix, and uniform composite properties beyond the matrix. The finite element results indicate that failure is dominated by the interfacial shear stress component which reaches a maximum value at a distance of approximately half the fiber diameter below the surface, and is insensitive to the local probe/fiber contact problem. The data reduction is only approximate since the complete geometry of each local fiber arrangement cannot be included for every test. Thus, the interfacial strength is considered to be a nominal value for some equivalent fiber arrangement characterized only by the distance to the nearest neighbor fiber. Author

N86-29907*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TENSION STRENGTH OF A THICK GRAPHITE/EPOXY LAMINATE AFTER IMPACT BY A 1/2-IN. RADIUS IMPACTOR
C. C. Poe, Jr., W. Illg, and D. P. Garber (PRC Kentron, Inc., Hampton, Va.) Jul. 1986 130 p
(NASA-TM-87771; NAS 1.15:87771) Avail: NTIS HC A07/MF A01 CSCL 11D

NASA is developing graphite/epoxy filament-wound cases for solid rocket motors of the space shuttle. They are wet-wound with AS4W graphite fiber and HBRF-55A epoxy. The membrane region is about 1.4 inches thick. Two 30-inch-diameter by 12-inch-long cylinders were impacted every two inches of circumference with 1/2-inch radius impactors that were dropped from various

heights. One cylinder was empty and the other was filled with inert propellant. Two-inch-wide test specimens were cut from the cylinders. Each was centered on an impact site. The specimens were x-rayed and loaded to failure in uniaxial tension. Rigid body mechanics and the Hertz law were used to predict impact force, local deformations, contact diameters, and contact pressures. The depth of impact damage was predicted using Love's solution for pressure applied on part of the boundary of a semi-infinite body. The predictions were reasonably good. The strengths of the impacted specimens were reduced by as much as 37 percent without visible surface damage. Even the radiographs did not reveal the nonvisible damage. Author

N86-29908*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CARBON-RICH CERAMIC COMPOSITES FROM ETHYNYL AROMATIC PRECRUSORS
Frances I. Hurwitz 1986 13 p Presented at the Tenth Annual Conference on Composites and Advanced Ceramic Materials, Cocoa, Beach, Fla., 19-24 Jan. 1986; sponsored by the American Ceramic Society
(NASA-TM-88812; E-3167; NAS 1.15:88812) Avail: NTIS HC A02/MF A01 CSCL 11D

A number of polyfunctional aromatic acetylenes thermally polymerize at low temperatures (180 C) and pyrolyze with greater than 90 char yield. In nonoxidizing environments, they are thermally stable to 1450 C. These monomers were chosen as the basis of a model system to study the fabrication and mechanical properties of continuous filament ceramic matrix composite. Composites were fabricated from aryl poly(acetylenes), SiC particulate filler and graphite, Avco SiC, Nicalon and Nextel fibers. Microstructure, physical and mechanical properties are reported. Author

N86-29909# Florida Univ., Gainesville. Dept. of Engineering Sciences.
IMPROVEMENT AND OPTIMIZATION OF INTERNAL DAMPING OF FIBER REINFORCED COMPOSITE MATERIALS Final Report, Jun. 1983 - Nov. 1985
C. T. Sun 17 Dec. 1985 174 p
(Grant AF-AFOSR-0154-83)
(AD-A166173; AFOSR-86-0049TR) Avail: NTIS HC A08/MF A01 CSCL 11/4

Analysis of material damping and optimization of both material damping and specific stiffness of laminated, continuous or discontinuous fiber reinforced polymer matrix is the major objective of this study. The analytical solution was achieved by using a force-balanced model to derive the equivalent modulus of unidirectional aligned short fiber composites. We then apply the elastic-viscoelastic correspondence principle and separating the real and imaginary parts to obtain the storage and the loss moduli of the composite. In laminated composites we also investigate the influence of interlaminar stress on damping. To this end, we use a finite-element program to evaluate the three-dimensional stress distribution in the plane of each lamina and also at each interface. We then formulate the total strain energy and apply the elastic-viscoelastic correspondence principle to obtain the analytical expression of damping of laminated composites, which is defined as the ratio of the energy dissipated per cycle and the total energy. Analytical results are compared with those obtained from classical two-dimensional lamination theory. Sequential Simplex method, laminated plate theory, and an elastic-viscoelastic correspondence principle are used to optimize both material damping and a specific stiffness of composites. GRA

N86-29910# Institute for Defense Analyses, Alexandria, Va.
A BRIEF ASSESSMENT OF STRUCTURAL COMPOSITE MATERIALS RESEARCH IN UNIVERSITIES IN THE UNITED STATES Final Report, Oct. 1984 - Oct. 1985
R. L. Kerber Dec. 1985 30 p
(Contract MDA903-84-C-0031)
(AD-A166665; AD-E500759; IDA-M-156; IDA/HQ-86-30809) Avail: NTIS HC A03/MF A01 CSCL 11/4

The use of advanced composite structural materials in defense systems is rapidly increasing and it is expected that this trend will continue in the foreseeable future. Thus, it is important to assess the role of universities to support the technology base and provide appropriate manpower to the defense industry. The results of such a survey and assessment are presented. It is recommended that DARPA support about 5-8 new university-operated composite material activities which should have a strong interaction with industry. Suggested funding needs and technical initiatives are outlined. GRA

N86-29911# IIT Research Inst., Chicago, Ill.
NONDESTRUCTIVE EVALUATION OF METAL MATRIX COMPOSITES Final Report, 12 Apr. 1982 - 30 Jun. 1984
S. W. Schramm, G. M. Koller, and J. W. Adams Dec. 1985 118 p
(Contracts DAAG46-82-C-0039; DA Proj. 1L2-63102-D-071)
(AD-A166774; IITRI-K06035-30; MTL-TR-85-31) Avail: NTIS HC A06/MF A01 CSCL 11/4

The objective of this program was to apply nondestructive evaluation (NDE) methods to identify potentially harmful casting defects in FP/magnesium composites; establish detectability and reproducibility limits of NDE applied to FP/magnesium composites; and establish relationships between casting defects and failure modes of FP/magnesium composites. The material investigated was ZE41A magnesium alloy reinforced with FP (aluminum oxide) fibers. The 27 coupons (four coupons each of five flaw types and seven coupons from a related program were evaluated using ultrasonic scanning, wave propagation velocity, and wave attenuation inspection techniques. The coupons evaluated were 12.7 cm (5 in.) long x 3.8 cm (1.5 in.) wide x 0.6 cm (0.25 in.) thick, with a fiber volume fraction of 0.50. After the detectability and reproducibility NDE inspections, tensile and/or bend specimens were machined from the parent coupons, strain gaged, and statically loaded to failure. Micrographs were made of the fracture surfaces for comparison with the NDE records. It was found that ultrasonic scanning using a 2 0 MHz compression wave, focused transducer operated in the pulse-echo mode generating an analog C-scan provided 100% detectability and reproducibility of the intentionally flawed coupons. GRA

N86-29912# Department of the Air Force, Washington, D.C.
PHENYLQUINOXALINE RESIN COMPOSITIONS Patent Application
Marilyn R. Unroe, inventor (to Air Force) Filed 16 Jan. 1986 15 p
(AD-D012230; US-Patent-Appl-SN-819322) Avail: NTIS HC A02/MF A01 CSCL 11/9

This invention relates to phenylquinoxaline resin compositions. The acetylene-terminated polyphenylquinoxalines disclosed in previous patents represent promising new matrix resins for advanced structural materials. These materials propagate and cure by addition reactions to form high molecular weight, thermally stable compositions. The addition process obviates all problems associated with volatile by-product formation that occurs when such materials are prepared by condensation processes. The thermally induced free radical polymerization of aromatic and heterocyclic diacetylenes provides a linear conjugated polyene of 6 to 8 repeating units which results in a cluster-shaped species whose growth is inhibited by the steric hindrance of the monomer or oligomer backbone structure. Although the free radical at the hub of the cluster is reactive its growth becomes increasingly more difficult as the reacton proceeds, reaching a finite limit. Subsequent reaction of dangling acetylene groups of a cluster results in a highly cross-linked polyene network. Such cross-linking has a direct effect on the network topology which manifests itself in mechanical behavior. It is an object of the present invention to provide novel quinoxaline resin systems having a low crosslink density. GRA

N86-29913# North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Mechanical Engineering.
EFFECTS OF THERMAL AND CYCLIC LOADS ON SILICON CARBIDE YARN REINFORCED GLASS MATRIX COMPOSITES

Progress Report, Feb. 1 - 31 Dec. 1985
V. S. Avva and J. Sankar 15 Jan. 1986 7 p
(Contract DE-FG05-84ER-45140)
(DE86-006793; DOE/ER-45140/2) Avail: NTIS HC A02/MF A01

Six panels of SiC/7740 borosilicate composite materials were studied. Static ultimate strength, strain values, and fatigue of the laminate were determined. DOE

N86-29914# Los Alamos National Lab., N. Mex.
PERFORMANCE OF COMMERCIAL AND RESEARCH GRADE SiC WHISKERS IN A BOROSILICATE GLASS MATRIX
F. D. Gac, J. J. Petrovic, J. V. Milewski, and P. D. Shalek 1986 13 p Presented at the 10th Annual Conference on Composites and Advanced Ceramic Materials, Cocoa Beach, Fla., 19 Jan. 1986
(Contract W-7405-eng-36)
(DE86-007379; LA-UR-86-628; CONF-860152-1) Avail: NTIS HC A02/MF A01

Dry blending of the whiskers and glass powder yielded composites of satisfactory, but not optimum, homogeneity is discussed. The whiskers inhibited composite densification, but this could be remedied by modifying the hot-pressing conditions. All types of whiskers produced improvements in the flexural strength of the composites, with the highest value achieved with the smallest diameter whiskers. The composites displayed a 4- to 5-fold increase in fracture toughness compared to that displayed by the unreinforced glass, but definitive trends could not be related to the whisker size characteristics. DOE

N86-29915# Colorado Univ., Boulder.
STUDIES OF METAL/CARBON SURFACE CHEMISTRY, SEPTEMBER 1, 1985-November 30, 1985
B. E. Koel 31 Dec. 1985 5 p
(Contract DE-FG22-84PC-70779)
(DE86-007419; DOE/PC-70779/6) Avail: NTIS HC A02/MF A01

The purpose of this research is to identify stable surface species formed from molecular adsorption and reaction on metal/carbon surfaces. This research has practical application in improving the fundamental understanding of catalytic coal gasification. Well-defined model catalysts for carbon gasification will be studied by vapor depositing alkali and transition metal atoms on carbon surfaces. Vibrational spectroscopy using high resolution electron energy loss spectroscopy (HREELS) and photoelectron spectroscopy of these surfaces will be used to develop an atomic-level understanding of the chemical bonding, structure, and reactivity of the metal carbon surface and of the adsorbed molecular species. DOE

N86-29916# Cornell Univ., Ithaca, N.Y. School of Mechanical and Aerospace Engineering.
EXPERIMENTS AND MICROMECHANICAL MODELS FOR CREEP-RUPTURE IN POLYMER MATRIX COMPOSITES Progress Report, 15 Jun. 1985 - 14 Jun. 1986
S. L. Phoenix Mar. 1986 9 p
(Contract DE-FG02-84ER-45112)
(DE86-007980; DOE/ER-45112/2) Avail: NTIS HC A02/MF A01

The purpose is to develop statistical and micromechanical models of time-dependent failure in fiber composites in order to forecast long-term reliability. Three problems are being studied: micromechanics of stress transfer at fiber fracture sites; modeling time-dependent effects in both fiber and matrix under one unified power-law framework; and creep-rupture of single Kevlar 49 fibers at high temperatures up to 200 C. DOE

N86-29917# Foersvarets Forskingsansalt, Stockholm (Sweden).
MATERIAL PROPERTIES OF EPOXY RESINS REINFORCED WITH CARBON FIBERS, AFFECTED BY HEAT RADIATION
Fritz Larsson Jan. 1986 64 p In SWEDISH; ENGLISH summary
(FOA-C-20597-F9; ISSN-0347-3694; ESA-86-97235) Avail: NTIS HC A04/MF A01

Carbon fiber reinforced epoxy resins of aircraft quality (unidirectional laminates of thickness 0.95, 1.86, and 3.91 mm, and cross-ply laminates of 1.82 mm thickness) were exposed on one surface to heat radiation with intensity 7.5 to 60 kW/sqm. Temperature as a function of time was calculated for points on the surface as well as for points within the laminate, and formulas for determining the temperature at which damage occurs are given: the lowest is 260 C. The mass loss for a damage spread through the material is < 1%. The residual mechanical strength after the heat radiation was measured, and exposure time resulting in visible defects was determined. ESA

N86-29918# Foersvarets Forskingsansalt, Stockholm (Sweden).
PARTICLES AND GASES PRODUCED BY CUTTING FIBER COMPOSITES WITH A 250 W CONTINUOUS WAVE CARBON DIOXIDE LASER
Tom Karlsson Feb. 1986 33 p In SWEDISH; ENGLISH summary
(FOA-C-20599-D6; ISSN-0347-3694; ESA-86-97236) Avail: NTIS HC A03/MF A01

Four matrices reinforced with unidirectional HT-carbon fibers and three epoxides reinforced with E-glass, Kevlar, and boron fibers were cut with nitrogen or air in the protective gas jet. Carbon fibers were vaporized: 90% are oxidized to carbon monoxide and carbon dioxide by the surrounding air. The glass from the glass fiber composite was quantitatively recovered as small pearls or as a very fine powder, the matrix being totally vaporized. About 3.5% of the Kevlar composite formed gases and the rest a powder and half molten, short pieces of Kevlar fibers. The boron fibers melt and a small part was oxidized to boron trioxide, the matrix being totally destroyed. Quantitative measurements of the carbon-oxides, hydrocyanic acid, and the nitrogen oxides were made.ESA

N86-29919# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Dept. Production-Recherches.
GENERAL INVESTIGATIONS OF COMPOSITE MATERIALS. ADHESIVE BONDING OF CARBON COMPOSITES Final Report [ETUDES GENERALES SUR LES MATERIAUX COMPOSITES]
P. Dublineau and G. Durivaud 14 Dec. 1985 75 p In FRENCH
(Contract STPA-83-96-003-00-471-75-86)
(SNIAS-2647/DCI-PR/85; ESA-86-97268) Avail: NTIS HC A04/MF A01

The influence of the polymerization cycle and atmospheric moisture on the final properties of epoxy-amine adhesives used for adhesive bonding of carbon fiber composites is studied. The analysis of the polymerization time or temperature effects does not show a significant effect. Moisture absorption is shown to have a negative effect on the bonded joint properties. Different elements, either epoxy-carbon composites or bonded joints, could be processed simultaneously in the polymerization autoclave. ESA

N86-29920# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Service Technique des Programmes Aeronautiques.
INFLUENCE OF THE TEST METHOD AND THE MATERIAL STIFFNESS ON THE LOW VELOCITY IMPACT DAMAGE OF CARBON-EPOXY COMPOSITES, PART 2 [INFLUENCE DE LA METHODE D'ESSAI ET DE LA RIGIDITE DU MATERIAU SUR LES DOMMAGES OCCASIONNES PAR LES CHOCS A BASSE VITESSE SUR COMPOSITES CARBONE EPOXY (DEUXIEME PARTIE)]
G. Hilaire and B. Soulezelle 27 Dec. 1985 81 p In FRENCH
(Contract STPA-83-96003)
(PV-47-166/F-Pt-2; ESA-86-97269) Avail: NTIS HC A05/MF A01

The performance of carbon-epoxy materials and the influence of the stiffness of the specimen are studied. The IM6 and AS6 fibers with the Narmco 5245 resin composites show impact damage at higher energy levels. The effect of stiffness on the T300 fiber with Narmco 5208 resin composites is clearly negative for all tested composite assembling combinations. A large reduction of the composite compression resistance (50% to 65%) is observed in all specimens showing impact damage. ESA

N86-29921# Societe Nationale Industrielle Aerospatiale, Suresnes (France).
AGING OF CARBON-EPOXY COMPOSITE IN HUMID ENVIRONMENTS [VIEILLISSEMENT HUMIDE DES COMPOSITES CAR-

BONE-EPOXY]
G. Hilaire and J. N. Dewas 23 Oct. 1985 173 p In FRENCH
(Contract DRET-81-34-250-00)
(PV-42-791/F; ESA-86-97270) Avail: NTIS HC A08/MF A01

The influence of temperature-humidity cycles on the water diffusion kinetics in T300/914 and T300/5208 composites was studied. The evolution of the coefficients of the Langmuir model was analyzed as a function of temperature, humidity, and the number of absorption cycles. The glass transition point was determined after each cycle. The consequences of thermal shock and the influence of a moisture barrier paint are also examined. A total of 168 specimens were tested. It is found that moisture absorption increases after a first cycle and is stable afterwards. The diffusion coefficient is temperature dependant following an Arrhenius function. A different behavior under thermal shock is found for the two composites. Protective paints do not show significant effects. The complexity of a model that could include all experimental data is pointed out. ESA

N86-29922# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique des Materiaux.
DETERMINATION OF THE BASIC PARAMETERS IN THE MICROMECHANICAL BEHAVIOR OF COMPOSITE MATERIALS [DETERMINATION DES PARAMETRES ESSENTIELS DANS LE COMPORTEMENT MICROMECANIQUE DES MATERIAUX]
J. P. Favre, C. Marais, and P. Sigety Feb. 1985 60 p In FRENCH
(Contract DRET-84-34-001)
(ONERA-RT-41/7086-M; ESA-86-97275) Avail: NTIS HC A04/MF A01

Cracking and delamination faults are studied in order to identify the parameters and to develop composite choice criteria. The experimental design is limited to composite structures to avoid considering spurious problems. The specimens are carbon-epoxy composites with unidirectional 14 layer structure. The results show that the breaking energy is a function of the damaged length. It is possible to differentiate three phases of the failure mechanism: initiation, propagation, and crack stabilization. The dispersion of the results is related to the specimen morphology. The factors explaining the variance of the results are discussed. ESA

N86-29923# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Struct
INVESTIGATION OF DELAMINATION OF A COMPOSITE BAR Final Report [ETUDE DU DELAMINAGE D'UN BARREAU COMPOSITE]
L. Anquez and F. Nataf Dec. 1985 42 p In FRENCH
(Contract DEN-84-70-145)
(ONERA-RT-9/3542-RY-044-R; ESA-86-97277) Avail: NTIS HC A03/MF A01

A finite element numerical study was carried out to simulate a cracked bar and to compute the energy related to the shape of the crack. Analytical computations are also presented. It is shown that when the length of crack is larger than twice the thickness of a composite layer, the analytical computation works well giving the energy along the three axes and the crack opening in two axes. Numerical results showing the values of the restitution energy as a function of the crack length are presented. Coming up from the bottom of the crack the profile is a straight line with slope which is a function of the crack length. ESA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N86-29924*# Polyatomics Research, Inc., Mountain View, Calif.
ON THE EXTENSION OF THE MCSCF/CI METHOD Final Report, 15 Sep. 1981 - 31 Aug. 1984
Charles Bauschlicher, Jr., Constance J. Nelin, and Andrew Komornicki 31 Aug. 1984 112 p
(Contract NCC2-158)
(NASA-CR-176933; NAS 1.26:176933) Avail: NTIS HC A06/MF A01 CSCL 07D

Research conducted during this period was focused on two main areas: (1) bonding in transition metal oxides; and (2) adsorption of CO on Al and Ni. In both of these theoretical studies a major interest was to obtain a better understanding of the nature of the bonding in transition metal containing systems. The studies used self consistent field (SCF), multi-configuration self cosistent field (MCSCF) and configuration interaction (CI) methods in the treatment of the transition metal oxides and only the SCF method in the adsorption studies. The reports of three principle investigators who contributed to this work during the tenure of the project are presented along with associated published papers. For individual titles, see N86-29925 through N86-29929.

N86-29925*# Polyatomics Research, Inc., Mountain View, Calif.
THE NATURE OF CHEMISORBED OXYGEN ON Ni(100) AND Cu(100)
Charles W. Bauschlicher, Jr., Stephen P. Walch, Paul S. Bagus (IBM Research Lab., San Jose, Calif.), and C. R. Brundle *In its* On the Extension of the MCSCF/CI Method 31 Aug. 1984 9 p (For primary document see N86-29924 21-25)
Avail: NTIS HC A06/MF A01 CSCL 07D

Model calculations indicate two low-lying states for the interaction of O with Ni and Cu(100). The oxide state is approximately 1 eV more stable and its R(perpendicular) for Ni(100) is consistent with the experimental value for Ni(100), indicating only one type of stable chemisorption bond. This agrees with XPS (X-ray photoemission spectroscopy) and EXAFS (extended X-ray absorption fine structure) data for the observed LEED (low energy electron diffraction) structures. Interpretations of EELS (electron energy loss spectroscopy) data in terms of a radical state forthe p(2x2) and the oxide state for the c(2x2) structure must be seriously questioned. Author

N86-29926*# Polyatomics Research, Inc., Mountain View, Calif.
A FINAL REPORT ON THE EXTENSION OF THE MCSCF/CI METHOD
Constance J. Nelin *In its* On the Extension of the MCSCF/CI Method 31 Aug. 1984 28 p (For primary document see N86-29924 21-25)
Avail: NTIS HC A06/MF A01 CSCL 07D

For the period of July 1982 through January 1983, the research carried out focused on the nature of metal adsorbate bonding. Two main areas were investigated in detail: (1) the adsorption of CO on Al, Na, Mg and Ni; and (2) bonding in transition metal oxides, CuO, CrO and MoO. These theoretical studies have lead to a new understanding of CO-metal bonding as well as to a better understanding of the d involvement in the bonding in transition metal oxides. Four areas associated with cluster model studies are discussed in detail: hybridization and changing in cluster model studies, the adsorption of CO on metals (Al, Na, Mg), the adsorption of CO on Ni, and finally the use of effective core potentials (ECP) in cluster models. Author

N86-29927*# Polyatomics Research, Inc., Mountain View, Calif.
CHARGING AND HYBRIDIZATION IN THE FINITE CLUSTER MODEL
Charles W. Bauschlicher, Jr., Paul S. Bagus (IBM Research Lab., San Jose, Calif.), and Constance J. Nelin *In its* On the Extension of the MCSCF/CI Method 31 Aug. 1984 14 p (For primary document see N86-29924 21-25)
Avail: NTIS HC A06/MF A01 CSCL 07D

Cluster wavefunctions which have appropriate hybridization and polarization lead to reasonable properties for the interaction of an adsorbate with a solid surface. However, for Al clusters, it was

found that the atomic change distribution is not uniform. The finite cluster size leads to changes not representative for an extended system. This effect appears to be dependent on the particular materials being studied; it does not occur in all cases. Author

N86-29928*# Polyatomics Research, Inc., Mountain View, Calif.
ON THE LOW-LYING STATES OF CuO
Paul S. Bagus (IBM Research Lab., San Jose, Calif.), Constance J. Nelin, and Charles W. Bauschlicher, Jr. *In its* On the Extension of the MCSCF/CI Method 31 Aug. 1984 20 p (For primary document see N86-29924 21-25)
Avail: NTIS HC A06/MF A01 CSCL 07D

Self consistent field and correlated wave functions have been computed for the ground and for several low-lying states of CuO. The ground state is X(2)PI and the lowest excited state, at approximately 8,000/cm above X(2)PI, is a previously unidentified 2-sigma(+) state. The separation of these states is compared to that for the similar states of KO and is analysed in terms of integrals between orbitals of the separated free ions. A classification of the states of the molecule based on states of Cu(+) and O(-) which leads to a division into manifolds of states arising from Cu(+) 3d(10) and Cu(+) 3d(9) 4s(1) is considered. It is predicted that the state of the 3d(9) 4s(1) manifold are 10,000 to 30,000/cm above the ground state and assign the observed A2-sigma(+) state at 16,500/cm to this manifold. M.G.

N86-29929*# Oslo Univ. (Norway). Dept. of Chemistry.
A VECTORIZED MOLECULE CODE Final Report
Jan Almloef *In* Polyatomics Research, Inc.,Mountain View, Calif. On the Extension of the MCSCF/CI Method 31 Aug. 1984 26 p (For primary document see N86-29924 21-25)
Avail: NTIS HC A06/MF A01 CSCL 07D

The vectorization of the computational chemistry code, MOLECULE, is discussed. Computational simplifications of molecular integrals, memory management, and contraction schemes are addressed and a brief guide for users is included. M.G.

N86-29930*# National Aeronautics and Space Administration, Washington, D.C.
PRODUCTION OF AN ION-EXCHANGE MEMBRANE-CATALYTIC ELECTRODE BONDED MATERIAL FOR ELECTROLYTIC CELLS
Hiroyasu Takenaka and Eiichi Torikai Apr. 1986 10 p Transl. into ENGLISH from Japanese Patent No. 55-38934, (Appl. 78/110,267 7 Sep. 1978) 18 Mar. 1980 p147-150 Transl. by Scitran, Inc., Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88392; NAS 1.15:88392) Avail: NTIS HC A02/MF A01 CSCL 07D

A good bond is achieved by placing a metal salt in solution on one side of a membrane and a reducing agent on the other side so that the reducing agent penetrates the membrane and reduces the metal. Thus, a solution containing Pt, Rh, etc., is placed on one side of the membrane and a reducing agent such as NaBH, is placed on the other side. The bonded metal layer obtained is superior in catalytic activity and is suitable as an electrode in a cell such as for solid polymer electrolyte water electrolysis. Author

N86-29931# Toronto Univ. (Ontario). Dept. of Chemistry.
MOLECULAR DYNAMICS OF REACTIONS FORMING ELECTRONICALLY EXCITED PRODUCTS Final Report, 15 Oct. 1980 - 14 Oct. 1985
J. C. Polanyi 22 Dec. 1985 6 p
(Grant AF-AFOSR-0027-81)
(AD-A166168; AFOSR-86-0133TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

The objective of this research was to improve understanding at a fundamental level of chemical processes leading to the formation of electronically excited products (nonadiabatic processes). The quasi-classical trajectory (QCT) method was used in order to map out various types of nonadiabatic dynamics, and to correlate these types of behavior with the interaction potentials that give rise to them. Three dimensional trajectory surface hopping (TSH) was applied to pairs of potential energy surfaces that interacted along a seam in the exit valley (i.e. as products separated). This report summarizes the molecular dynamics of exoergic chemical reactions that yield products in both ground and electronically excited states. GRA

N86-29932# M L Energia, Inc., Princeton, N.J.
RADIATIVE AUGMENTED COMBUSTION Annual Report, 15 Jul. 1984 - 14 Jul. 1985
Moshe David 12 Aug. 1985 87 p
(Contract F49620-83-C-0133)
(AD-A166185; ENG-102-ATR-8508; AFOSR-86-0085TR; AR-2)
Avail: NTIS HC A05/MF A01 CSCL 07/5

Radiative augmented combustion is based on the fact that radiation of selected wavelengths is capable of photodissociating stable molecules, combustion intermediates and other inhibiting species into reactive radicals. Subsequent increases in concentrations of these radicals can modify the overall kinetics and produce radiative ignition and combustion enhancements. The potential of this technique was previously demonstrated under static conditions. Recently, it has been also demonstrated under flow conditions, with advanced vacuum ultraviolet (VUV) and ultraviolet (UV) light sources. This program emphasizes research on the interaction between VUV/UV radiation and combustion under flow conditions. The main objective is to demonstrate proof of concept by radiatively igniting combustible mixtures at conditions where thermal ignition is unreliable. Additional objectives are to provide non-intrusive (optical) flameholding and to increase flame speed. Another important goal is to improve the fundamental understanding of the role of photochemical reactions within the whole kinetic scheme, and ultimately to identify the most effective photodissociative path. Consequently, the program is divided into two main subjects: ignition and enhancement. GRA

N86-29933# California Univ., Berkeley. Dept. of Mechanical Engineering.
APPLICATION OF RAYLEIGH SCATTERING TO TURBULENT FLOW WITH HEAT TRANSFER AND COMBUSTION Annual Report, 1 May 1984 - 30 Apr. 1985
L. Talbot 7 Aug. 1985 7 p
(Grant AF-AFOSR-0124-84)
(AD-A166223; AFOSR-86-0072TR) Avail: NTIS HC A02/MF A01 CSCL 21/2

Studies of premixed turbulent V-shaped flames have been carried out using two-point Rayleigh scattering. Density fluctuation intensities, two point density covariances, and mean density profiles were found to be in good agreement with a wrinkled laminar flame model which is an extension of the Bray Moss Libby model. The probability density function for the location of the flame sheet within the turbulent flame brush was measured and found to be approximately gaussian. Mean density profiles of the turbulent flame brush were found to have a self similar behavior when scaled with the maximum slope thickness. A new optical system was developed to make time resolved Rayleigh scattering measurements along a length of a laser beam, thus extending the two point technique to a multipoint one. GRA

N86-29934# California Univ., Santa Barbara. Quantum Inst.
CLUSTER-MODEL CALCULATION OF RAMAN INTENSITY FOR VIBRATION OF CO ADSORBED ON COPPER Annual Report
Ji-An Wu, Horia Metiu, and Bernard Kirtman Feb. 1986 28 p Submitted for publication
(Contract N00014-81-K-0598; Grant NSF CHE-82-06130)
(AD-A166239; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07/4

The discovery of surface enhanced Raman spectroscopy has inspired a large body of work which has been summarized in several recent review articles. While much has been learned about various enhancement sources there is still disagreement regarding the proportion in which different factors contribute to the observed Raman cross section. Even though it is difficult to include all the opinions in a broad classification, it is fair to say that the main debate is centered around the relative importance

of chemical versus electromagnetic (EM) enhancement factors. As emphasized in the Introduction, the intention was to estimate to what extent the non-resonant Raman signal for the C-O stretch is increased when CO binds to a Cu surface. An HCUCO cluster has been used to simulate the on-top binding of CO on Cu(100). The fact that our cluster reproduces the binding properties of adsorbed CO and the CO valence orbitals of pyramidal Cu5CO gives us hope that a correct estimate of the Raman intensity has been obtained. This is especially likely since the property sought is a local quantity. Our result is that the chemical enhancement is about a factor of four which is in general agreement with the few careful estimates based on experimental data. We emphasize that the present calculation does not deal with the question of resonant enhancement. GRA

N86-29935# California Univ., Santa Barbara. Quantum Inst.
AN EFFICIENT METHOD FOR SOLVING QUANTUM LIOUVILLE EQUATION: APPLICATIONS TO ELECTRONIC ABSORPTION SPECTROSCOPY Annual Technical Report
Bo Hellsing and Horia Metiu Feb. 1986 20 p
(Contract N00014-81-K-0598)
(AD-A166260; TR-14) Avail: NTIS HC A02/MF A01 CSCL 07/4

We examine a method for solving Liouville's equation, consisting of successive application of short time propagators which are evaluated by using fast Fourier transforms. The method is examined numerically by computing electronic absorption spectra. The procedure is very efficient when applied to the study of short time dynamics of systems whose quantum degrees of freedom are spatially localized. GRA

N86-29936# Washington State Univ., Pullman. Shock Dynamics Lab.
ELECTRONIC SPECTRA OF VARIOUS LIQUIDS UNDER SHOCK CONDITIONS Annual Report, 1 Oct. 1984 - 30 Sep. 1985
George E. Duvall 30 Dec. 1985 38 p
(Contract N00014-77-C-0232)
(AD-A166510; AD-E750871) Avail: NTIS HC A03/MF A01 CSCL 07/4

A series of experiments is described in which the time resolve spectra of several liquids have been recorded as they were compressed by shock waves reverberating between two sapphire plates. The extent of chemical reaction is reported as indicated by red shift of the uppermost absorption band in the UV or visible. Most of the liquids were organic materials containing 0,1 or 2 carbon double bonds. Unsaturated substances are, on the whole, more reactive than saturated ones, but the relation is not simple. One of the few inorganics studied was HI, which reacted very rapidly an in two stages. Some comments on possible mechanism are included, along with cautions about the interpretation of this kind of experiment. GRA

N86-29937# Georgia Univ., Athens. Dept. of Chemistry.
GRAPH THEORY IN THE STUDY OF METAL CLUSTER BPONDING TOPOLOGY: APPLICATIONS TO METAL CLUSTERS HAVING FUSED POLYHEDRA
R. B. King 2 Apr. 1986 26 p
(Contract N00014-85-K-0365)
(AD-A166623; TR-20) Avail: NTIS HC A03/MF A01 CSCL 07/4

The energy levels in delocalized two- or three-dimensional chemical structure are related to the eigenvalues of the graph representing the corresponding bonding topology. Such relatively crude but computationally undemanding graph theory derived models provide a clear demonstration of the close relationship between two-dimensional aromatic systems such as benzene and three-dimensional aromatic systems such as deltahedral boranes, carboranes, and metal clusters. The basic building blocks for the three dimensional aromatic systems are deltahedra having no degree 3 vertices. Delocalized bonding in such systems having v vertices requires two electrons for a multicenter core bond as well as 2v electrons for pairwise surface bonding. A problem of particular interest is how metal cluster polyhedra can fuse together leading ultimately to the infinite structures of the bulk metals. As a model for such processes the fusion of rhodium carbonyl octahedra is examined using graph theory derived methods. These lead to reasonable electron-precise models for the bonding topologies in the 'biphenyl an alogue (Rh12(CO)30)2-, the naphthalene analogue (Rhg(CO)19)3-, the anthracene analogue H2Rh12 (CO)25, and the perinaphthene analogue (Rh11(CO)23)3-. Similar models can also be developed for clusters based on centered larger rhodium polyhedra as exemplified by the centered cuboctahedral clusters of the type (Rh13(CO)24H5-q)q- (q = 2, 3, 4) representing a fragment of the hexagonal close packed metal structure. Author (GRA)

N86-29938# Lawrence Livermore National Lab., Calif.
MODELING OF CHEMICAL KINETICS IN PULSE COMBUSTORS
C. K. Westbrook Sep. 1985 20 p Presented at the Fall Meeting of the American Flame Research Committee, Livermore, Calif., 17 Oct. 1985
(Contract W-7405-eng-48)
(DE86-001571; UCRL-92765; CONF-8510182-1) Avail: NTIS HC A02/MF A01

Chemical kinetic modeling of the successive reignition of fuel-air mixtures, under conditions of pressure and temperature very similar to those encountered in conventional pulse combustion systems are described. The overall system model is described and the kinetic model is discussed in some detail. Computed results for ignition delay times are then related to time scales of interest in pulse combustion. From these comparisons, some of the physical and chemical factors which control the operation of the pulse combustor can be identified and quantified. In addition, the dependence of pulse combuston performance on various system parameters can be addressed, including the mass flow rate, fuel composition, presence of selected diluents and inhibitors, and combustion chamber geometry. DOE

N86-29939# Lawrence Livermore National Lab., Calif.
SIMULTANEOUS COMBUSTION SYNTHESIS AND DENSIFICATION OF REFRACTORY MATERIALS
J. B. Holt, S. M. Bianchini, and D. D. Kingman Jan. 1986 18 p Presented at the DARPA/ARMY Symposium, Daytona Beach, Fla., 21 Oct. 1985
(Contract W-7405-eng-48)
(DE86-006528; UCRL-93467; CONF-8510280-1) Avail: NTIS HC A02/MF A01

When the temperature of a self-propagating combustion reaction is below the melting temperature of the product, which is usually the case, the product is a powder or has a highly porous structure. Contributing to the large volume of porosity is the difference of molar volume of the products and reactants, porosity in the reactant compact prior to combustion, and the evolution of impurity gases during combustion. Since there is no data on the effect of volatile gases on the amount of porosity and the morphology of the pores in combustion products we will present the preliminary results of our research on the influence of different outgassing temperatures on the structure of 0.5 TiB - 0.5 tiB2, a product of the reaction Ti + 1.5 B. By combining the synthesis process with high pressure techniques, it is possible to densify the refractory products in one simple operation. Our experiments using a gas gun to apply large pressure waves immediately after combustion will be described for different chemical reactions. Both single phase (TiC) and composite materials (0.5 TiB - 0.5 TiB2, TiB2 - Fe and TiC - 2 Al2O3) have been simultaneously synthesized and densified to over 95% of theoretical density. DOE

N86-29940# Lawrence Livermore National Lab., Calif.
COMBUSTION SYNTHESIS OF SI3N4 AND AIN
J. B. Holt, D. D. Kingman, and G. M. Bianchini Jan. 1986 15 p Presented at the DARPA/ARMY Symposium, Daytona Beach, Fla., 21 Oct. 1985
(Contract W-7405-eng-48)
(DE86-006530; UCRL-93468; CONF-8510280-3) Avail: NTIS HC A02/MF A01

Si3N4 and AIN have been synthesized by combustion of the respective metal powders in high pressure nitrogen gas. The

Si3N4 product consists of a powder containing both the (ALPHA)- and (BETA)- forms. While operating in the pressure range of 100 to 1000 atmospheres, the highest yield for Si3N4 was 95%. An important parameter in producing a high yield is the silicon particle size. A silicon powder with an average particle size of 3 (MU)m was used in most of the experiments. The optimum experimental conditions are described for the synthesis of Si3N4. The AIN formed by the combustion of aluminum powders was in the forms of a dense (approx.92%) part. The experimental parameters control whether the combustion reaction goes to completion and the structure of the product. The preliminary results are favorable for the development of a process to produce dense AIN components using the combustion of aluminum powder in nitrogen gas. DOE

N86-29941# Lawrence Livermore National Lab., Calif.
DETECTION OF CHEMICAL VAPOR MIXTURES BY SORPTION ON MULTIPLE PIEZOELECTRIC CRYSTALS
D. U. Olness, T. B. Hirschfeld, K. Kishiyama, I., J. E. Lane, and R. J. Steinhause Nov. 1985 7 p Presented at the Chemical Defense Conference, Aberdeen Proving Ground, Md., 19 Nov. 1985
(Contract W-7405-eng-48)
(DE86-006698; UCRL-93121; CONF-8511140-3) Avail: NTIS HC A02/MF A01

The use of the piezoelectric sorption sensor, in which an analyte's absorption in a thin surface layer on a piezoelectric vibrator changes its resonant frequency, has been extensively described. Chemical selectivity of the device hinges on that of the absorbing layer. An alternative approach uses an array of crystals covered with a number of different absorbing layers. These are so thin that they operate in the saturation mode, with different partition coefficients against air, resulting in different frequency shifts for each layer. The behavior in Fourier space of these frequency shifts is then used for pattern recognition of individual chemicals. Mixture overlap can be handled via time derivative measurements, factor analysis, or correlation spectroscopy. A portable multichannel correlation piezobalance system has been built which has sensitivities well below 1 ug/lt, can be electrically tuned selectively to an arbitrary compound, responds in less than one minute, and can deal with mixed samples via a variety of algorithms. DOE

N86-29942# Council for Mineral Technology, Randburg (South Africa). Analytical Science Div.
DETERMINATION OF RELATIVE SENSITIVITY FACTORS FOR USE IN SPARK-SOURCE MASS SPECTROMETRY
D. C.G. Pearton 1 Feb. 1985 13 p
(DE86-700715; MINTEK-M-188) Avail: NTIS (US SAles Only) HC A02/MF A01

Six synthetic standards were prepared containing various combinations of 40 elements in a matrix of 90 percent silver. These synthetic standards were analyzed by spark-source mass spectrometry, and a large suite of relative sensitivity factors was compiled by use of 22 internal standards. DOE

N86-29943# Brookhaven National Lab., Upton, N. Y.
X-RAY STUDIES OF THE SOLID-ELECTROLYTE INTERFACE
W. E. OGrady Oct. 1985 4 p Presented at the In Situ Characterization in Electrochemical Processes, Denver, Colo., 18 Oct. 1985
(Contract DE-AC02-76CH-00016)
(DE86-003639; BNL-37260; CONF-8510243-1) Avail: NTIS HC A02/MF A01

This report contains an historical discussion of the techniques that have been used to study the composition and structure of the electrolyte/solid interface. Experiments which are presently being undertaken include extended x-ray absorption fine structure (EXAFS) and x-ray absorption near edge structure (XANES). Local electronic and geometric structures as well as long range order in solid-electrolyte interfaces can be determined with x-ray techniques. The influence of the electrode potential on the electronic and geometric structures of the platinum-phosphoric acid interface has already been observed. It now seems certain that the broad application of x-ray techniques to the studies of electrolyte interfaces will lead to an unprecedented growth in the knowledge and understanding of their structures. DOE

N86-29944# Los Alamos National Lab., N. Mex.
HYDROGEN-COMBUSTION ANALYSES OF LARGE-SCALE TESTS
R. G. Gido and A. Koestel 1986 9 p Presented at the Thermal Reactor Safety Meeting, San Diego, Calif., 2 Feb. 1986
(Contract W-7405-eng-36)
(DE86-004722; LA-UR-85-4172; CONF-860204-24) Avail: NTIS HC A02/MF A01

This report uses results of the large-scale tests with turbulence performed by the Electric Power Research Institute at the Nevada Test Site to evaluate hydrogen burn-analysis procedures based on lumped-parameter codes like COMPARE-H2 and associated burn-parameter models. The test results: (1) confirmed, in a general way, the procedures for application to pulsed burning, (2) increased significantly our understanding of the burn phenomenon by demonstrating that continuous burning can occur, and (3) indicated that steam can terminate continuous burning. Future actions recommended include: modification of the code to perform continuous-burn analyses, which is demonstrated; analyses to determine the type of burning (pulsed or continuous) that will exist in nuclear containments and the stable location if the burning is continuous; and changes to the models for estimating burn parameters. DOE

N86-29945# Argonne National Lab., Ill.
ELECTRODE KINETIC MEASUREMENTS OF VERY FAST REACTIONS: METAL DEPOSITION-DISSOLUTION IN MOLTEN HALIDES
Z. Nagy and J. L. Settle 1986 20 p Presented at the International Workshop on High Temperature Molten Salt Batteries, Argonne, Ill., 16 Apr. 1986
(Contract W-31-109-eng-38)
(DE86-006109; CONF-8604116-1) Avail: NTIS HC A02/MF A01

Metal deposition-dissolution reactions in molten salts are very fast and difficult to investigate, as evidenced by large discrepancies in the reported exchange current densities. An error analysis of the d-c relaxation techniques was carried out, and it was determined that the measurement of the exchange current density can have a systematic error if the surface reaction rate is much faster than the diffusion rate. This systematic error will result in measured exchange current densities approximately equal to the largest exchange current density measurable under the given conditions. This sytematic error can also result in fortuitously linear log i0 versus log C and log i0 versus 1/T plots, even when the results are grossly in error. A computer curve-fitting data evaluation coupled with a statistical sensitivity analysis is suggested to avoid these problems. The exchange current densities of iron, nickel and molybdenum were measured in LiCl-KCl eutectic melt at 450(0)C using an improved double pulse galvanostatic technique. Only that of iron could be measured reliably (1.7 +- 0.4 A c m(-2) at 1.3 x 10(-6) mol cm(-3) Fe(++) ion concentration), the nickel reaction is too fast to be measured (at least 5 A cm(-2) at 1 x 10(-6) mol cm(-3)Ni(++) ion concentration). The large discrepancies between these results and some results reported by earlier can be explained on the basis of error analysis. DOE

N86-29946# Sandia National Labs., Albuquerque, N. Mex.
ECUT PULSE COMBUSTION RESEARCH PROGRAM: A MILESTONE REPORT
T. T. Bramlette, ed. Feb. 1986 58 p
(Contract DE-AC04-76DR-00789)
(DE86-007747; SAND-85-8028) Avail: NTIS HC A04/MF A01

Purpose of this document is: (1) to report the technical progress achieved in the pulse combustion research project that is sponsored by the Energy Conversion and Utilization Technologies (ECUT) Program of the Department of Energy, and (2) to make the experimental and theoretical capabilities developed in this project known to a wide audience in order to stimulate collaborative interactions with manufacturers and potential users of pulse combustion equipment. The Sandia pulse combustion facility is

described in detail and the current understanding of the fluid mechanics, combustion, valving dynamics, chemical kinetics, and heat transfer associated with pulse combustion is summarized. The computer models are described and preliminary results discussed. Objectives and current status of the work recently initiated on a Rijke-type pulse combustor that burns liquid fuels are discussed. Finally, the future direction of the program is indicated. DOE

N86-29947# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
COMBUSTION IN IC ENGINES Final Technical Report, 1 Oct. 1980 - 31 Dec. 1985
F. V. Bracco Mar. 1986 14 p
(Contract DE-AC04-81AL-16338)
(DE86-007846; DOE/AL-16338/T2) Avail: NTIS HC A02/MF A01

A major accomplishment of this program has been the development of a state of the art engine combustion research laboratory where advanced laser diagnostic techniques are applied to making space and time resolved measurements of gas velocity, temperature and composition in four transparent-piston transparent-head single-cylinder research engines. In the world, this laboratory is a unique university facility and its use of advanced laser techniques is second only to the Combustion Research Laboratory at Sandia-Livermore. This is a laboratory that is capable of addressing the fundamental questions of engine combustion and of serving as an exceptional educational facility. Another major accomplishment of this research program is its contributions to the development of multi-dimensional engine combustion and engine spray models. These models are well regarded by automotive industries in three continents because their results are painstakingly checked against the detailed measurements made in our laboratory and in a few other places. Our models are now in use at General Motors, Volkswagen, Fiat, Cummins, Komatsu, and Nissan. DOE

N86-29948# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
DISCUSSION OF TURBULENT FLAME STRUCTURE IN PREMIXED CHARGES
J. Abraham, F. A. Williams, and F. V. Bracco 1985 16 p Presented at the SAE International Congress and Exhibition, Detroit, Mich., 27 Feb. 1985
(Contract DE-AC04-81AL-16338)
(DE86-008174; CONF-850254-5; SAE-Congr-850345) Avail: NTIS HC A02/MF A01

Propagation of turbulent flames in spark-ignition engines is considered from the viewpoint of the different possible regimes of premixed turbulent combustion. Nondimensional parameters defining known combustion regimes are reviewed, and numerical values of these parameters are estimated for both research and production engines. The reaction-sheet regime is inferred to apply at least for some operating conditions, and therefore literature on turbulent flame propagation in the reaction-sheet regime is reviewed. Implications of these results on interpretations of existing experimental observations of combustion in engine cylinders and on modeling of turbulent flame propagation in engines are discussed. DOE

N86-29949# Los Alamos National Lab., N. Mex.
TRANSPORT COEFFICIENTS FOR CARBON, HYDROGEN, AND THE ORGANIC MIXTURE C2H3
G. Rinker Feb. 1986 40 p
(Contract W-7405-eng-36)
(DE86-008323; LA-10608-MS) Avail: NTIS HC A03/MF A01

Electrical and thermal transport coefficients are calculated for amorphous elemental carbon and hydrogen, using the best available systematic theoretical methods. The density range considered is 10 to the minus 3 power g/cu.cm. less than or equal to rho less than or equal to 10 to the 6 power g/cu.cm. for carbon, and 10 to the minus 4 g/cu.cm. less than or equal to rho less than or equal to 10 to the 5 power g/cu.cm. for hydrogen. The temperature range considered is 10 to the minus 2 eV less than or equal to kT less than or equal to 10 to the 4th power eV. Calculational methods include relativistic partial-wave analysis of the extended Ziman theory, and nonrelativistic plane-wave analysis (Born approximation) of the original Ziman theory. Physical models include relativistic Dirac-Fock-Slater and nonrelativistic Thomas-Fermi-Dirac electron-ion potentials, and one-component-plasma ion-ion structure factors. A mixing algorithm is used to obtain approximate transport coefficients for the atomic ratio C2H3. DOE

N86-29950# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
LASER INDUCED FLUORESCENCE OF FCO RADICALS IN THE GAS PHASE [LASER INDUZIERTE FLUORESZENZ VON FCO-RADIKALEN IN DER GASPHASE]
G. Dornhoefer and W. Hack Sep. 1985 31 p In GERMAN; ENGLISH summary
(MPIS-17/1985; ISSN-0436-1199; ESA-86-96903) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 14

Laser induced fluorescence (LIF) of FCO in an isothermal flow reactor was studied in the pressure range between 0.5 and 11.2 mbar at room temperature. The FCO-radicals were generated in various chemical systems F+(CO and HFCO) and O+(C2F4, C2F3Cl, and C2F3H). A microwave discharge of COF2Ar and C2O2F2/Ar mixtures produced the FCO. No FCO-radicals are obtained in the IR multiphoton dissociation in COF2/Ar and C2O2F2/Ar mixtures. Excitation spectra were obtained in the wavelength range between 314.5 and 315.5 nm with a spectral resolution of 0.15 1/cm. Exciting at 315.06 nm, an emission spectrum in the range between 314.5 and 410 nm with bands separated by 630 1/cm is observed. The collisionless lifetime of the emitting state is 40 + or - 3 nsec. The chemical evidence indicating whether the FCO is responsible for the observed LIF-emission is discussed. ESA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N86-29951 British Library Lending Div., Boston Spa (England).
NON-METALLIC INCLUSIONS IN CAST LOW-ALLOY STEEL WITH TITANIUM ADDITIONS
V. I. Machikin, V. A. Kharchenko, and E. F. Dolzhenkova 1985 5 p Transl. into ENGLISH from Izv. VUZ Chernaya Metall. (USSR), no. 10, 1985 p 152
(BLL-M-36733-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

The influence of titanium on non-metallic inclusions in a low-alloy steel was investigated on 60 kg heats made in an induction furnace and cast into 5 kg ingots. It was found that with over 0.025% titanium its role mainly as a nitride-forming element is enhanced, titanium carbonitrides becoming the major part of the inclusions. Author

N86-29952 British Library Lending Div., Boston Spa (England).
PROPERTIES OF SPRING STEELS HARDENED IN POLYMER-BEARING MEDIUM
V. I. Alimov, V. T. Karbyshev, and O. G. Volkova 1985 4 p Transl. into ENGLISH from Izvestiya VUZ Chernaya Metallurgiya (USSR), no. 10, 1985 p 153-154
(BLL-M-36734-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

A study was made of the microstructure and mechanical properties of heat-treated spring steels 60S2 and 55S2 when a polymer-base coolant is used during hardening instead of petroleum oil. Author

N86-29953 British Library Lending Div., Boston Spa (England).
CONNECTION OF HIGH-TEMPERATURE STRENGTH AND STRUCTURAL STATE OF STEEL 12KhIMF WITH PARAMETERS

OF SIGNALS OF ACOUSTIC EMISSION UNDER TENSION
A. N. Smirnov and N. A. Chelyshev 1985 4 p Transl. into ENGLISH from Izvestiya VUZ Chernaya Metallurgiya (USSR), no. 10, 1985 p 156-157
(BLL-M-36738-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

An express method for estimation of long-term strength from the parameters of signals of acoustic emission under tension was investigated on heat-resistant pearlitic chromium-molybdenum-vanadium steel 12Kh1MF. A connection was established between the nature of signals of acoustic emission in 12Kh1MF and the structural state of the steel. Author

N86-29954 British Library Lending Div., Boston Spa (England).
CERTAIN RULES GOVERNING DAMPING OF VIBRATIONS IN TWO-PHASE ALLOYS
N. P. Borovkov and V. I. Kucherov 1986 10 p Transl. into ENGLISH from Izvestiya (USSR), p 115-119
(BLL-M-36760-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

The damping of vibrations in solids is investigated with special reference to two-phase alloys. A new model is proposed that permits the volume fractions, moduli of elasticity and relaxation times of elements and the frequency of vibrations to be linked to the logarithmic decrement. The model shows that minimal internal friction corresponds to maximal ratio of the moduli of elasticity and the relaxation times of the structural elements. Author

N86-29955 British Library Lending Div., Boston Spa (England).
DEPENDENCE OF BOND STRENGTH OF LAYERS ON ENERGY STATE OF CONTACT SURFACES DURING CLADDING OF BIMETALS
A. G. Kobelev, V. N. Lebedev, and A. M. Baiduganov 1985 4 p Transl. into ENGLISH from Izvestiya VUZ Chernaya Metallurgiya (USSR), no. 11, 1985 p 134-135
(BLL-M-36769-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

An investigation was made of the influence of the energy state of the contact surfaces on the bond strength of layers of steel-copper bimetals. Author

N86-29956 British Library Lending Div., Boston Spa (England).
POWDER METALLURGY: ACHIEVEMENTS, DETAILS AND PLANS
V. B. Akimenko 1985 16 p Transl. into ENGLISH from Stal. (USSR), no. 12, 1985 p 55-59
(BLL-M-36780-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

The history of powder metallurgy in the USSR is reviewed and new powder metallurgy techniques and technologies now being used or planned are discussed. Details of the considerable savings are given. A considerable contribution will be made to the economy. Author

N86-29957 British Library Lending Div., Boston Spa (England).
PROCESS OF STRUCTURE FORMATION OF SINTERED STEEL Kh6V3M
V. K. Narva, N. S. Loshkareva, and V. I. Nevzorov 1985 6 p Transl. into ENGLISH from Stal (USSR), no. 12, 1985 p 59-61
(BLL-M-36781-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

A study was made of the density and homogeneity of sintered iron-base material containing differing amounts of alloying elements. X-ray microanalysis and X-ray diffraction analysis were employed to investigate the structure of the sintered compositions and to establish the nature of the diffusion processes taking place during sintering. Author

N86-29958*# Eloret Corp., Sunnyvale, Calif.
STRUCTURAL CHARACTERIZAITON AND GAS REACTIONS OF SMALL METAL PARTICLES BY HIGH-RESOLUTION, IN-SITU TEM AND TED Annual Report, 1 Jan. - 31 Dec. 1984
1984 102 p
(Contract NCC2-283)
(NASA-CR-176905; NAS 1.26:176905) Avail: NTIS HC A06/MF A01 CSCL 11F

The existing in-situ transmission electron microscopy (TEM) facility was improved by adding a separately pumped mini-specimen chamber. The chamber contains wire-evaporation sources for three metals and a specimen heater for moderate substrate temperatures. A sample introduction device was constructed, installed, and tested, facilitating rapid introduction of a specimen into the mini-chamber while maintaining the background pressure in that chamber in the 10(-9) millibar range. Small particles and clusters of Pd, grown by deposition from the vapor phase in an in-situ TEM facility on amorphous and crystalline support films of alumina and on ultra-thin carbon films, were analyzed by conventional high-resolution TEM and image analysis in terms of detectability, number density, and size distribution. The smallest particles that could be detected and counted contained no more than 6 atoms; size determinations could be made for particles > 1 nm in diameter. The influence of various oxygen plasma treatments, annealing treatments, and of increasing the substrate temperature during deposition was investigated. The TEM technique was employed to demostrate that under otherwise identical conditions the lattice parameter of Pd particles in the 1 to 2 nm size range and supported in random orientation on ex-situ prepared mica films is expanded by some '3% when compared to 5 nm size particles. It is believed that this expansion is neither a small-particle diffraction effect nor due to pseudomorphism, but that it is due to a annealing-induced transformation of the small as-deposited particles with predominantly composite crystal structures into larger particles with true f.c.c. structure and thus inherently smaller lattice parameter. Author

N86-29959*# Eloret Corp., Sunnyvale, Calif.
STRUCTURAL CHARACTERIZATION AND GAS REACTIONS OF SMALL METAL PARTICLES BY HIGH-RESOLUTION TEM AND TED Semiannual Technical Report, 1 Jan. - 30 Jun. 1985
Klaus Heinemann 30 Jun. 1985 49 p
(Contract NCC2-283)
(NASA-CR-176949; NAS 1.26:176949) Avail: NTIS HC A03/MF A01 CSCL 11F

The interaction of 100 and 200 keV electron beams with amorphous alumina, titania, and aluminum nitride substrates and nanometer-size palladium particulate deposits was investigated for the two extreme cases of (1) large-area electron-beam flash-heating and (2) small-area high-intensity electron-beam irradiation. The former simulates a short-term heating effect with minimum electron irradiation exposure, the latter simulates high-dosage irradiation with minimum heating effect. All alumina and titania samples responded to the flash-heating treatment with significant recrystallization. However, the size, crystal structure, shape, and orientation of the grains depended on the type and thickness of the films and the thickness of the Pd deposit. High-dosage electron irradiation also readily crystallized the alumina substrate films but did not affect the titania films. The alumina recrystallization products were usually either all in the alpha phase, or they were a mixture of small grains in a number of low-temperature phases including gamma, delta, kappa, beta, theta-alumina. Palladium deposits reacted heavily with the alumina substrates during either treatment, but they were very little effected when supported on titania. Both treatments had the same, less prominent localized crystallization effect on aluminum nitride films. M.G.

N86-29960*# Eloret Corp., Sunnyvale, Calif.
THEORETICAL RESEARCH PROGRAM TO STUDY TRANSITION METAL TRIMERS AND EMBEDDED CLUSTERS Semiannual Progress Report
Stephen P. Walch 1985 72 p
(Contract NCC2-296)
(NASA-CR-176948; NAS 1.26:176948) Avail: NTIS HC A04/MF A01 CSCL 11F

Small transition metal clusters at a high level of approximation i.e. including all the valence electrons in the calculation and also including extensive electron correlation were studied. Perhaps the

most useful end result of these studies is the qualitative information about the electronic structure of these small metal clusters, including the nature of the bonding. The electronic structure studies of the small clusters are directly applicable to problems in catalysis. From comparison of dimers, trimers and possibly higher clusters, it is possible to extrapolate the information obtained to provide insights into the electronic structure of bulk transition metals and their interaction with other atoms and molecules at both surface and interior locations. Author

N86-29961*# National Aeronautics and Space Administration, Washington, D.C.
THERMAL SMOOTHING OF ROUGH SURFACES IN VACUO
Georg Wahl May 1986 14 p Transl. into ENGLISH from Forschung im Ingenieurwesen (West Germany), v. 37, no. 4, 1971 p 119-122 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88425; NAS 1.15:88425) Avail: NTIS HC A02/MF A01 CSCL 11F

The derivation of equations governing the smoothing of rough surfaces, based on Mullins' (1957, 1960, and 1963) theories of thermal grooving and of capillarity-governed solid surface morphology is presented. As an example, the smoothing of a one-dimensional sine-shaped surface is discussed. Author

N86-29962*# National Aeronautics and Space Administration, Washington, D.C.
OUTGASSING MEASUREMENT OF THE ALUMINUM ALLOY UHV CHAMBER
M. Miyamoto, T. Itoh, S. Komaki, K. Narushima, and H. Ishimaru Mar. 1986 10 p Transl. into ENGLISH of conference paper presented at the 8th Symposium on ISIAT, Japan, 1984 p 87-90; sponsored by the National Laboratory for High Energy Physics Symposium held in Ibaraki, Japan, 16 Oct. 1984 Submitted for publication Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASw-4006)
(NASA-TM-88433; NAS 1.15:88433) Avail: NTIS HC A02/MF A01 CSCL 11F

A large vacuum chamber (580 mm diameter) was fabricated from an aluminum alloy surface treated by a special process normally used on small chambers. The chamber was tested unbaked and baked at various temperatures, pressures, and holding periods. The chamber was filled with N2 gas, and the outgassing rate was measured after one hour. Then the ultimate pressure was measured. Outgassing rates for baked and unbaked groups were compared. It is concluded that the same surface treatment technique can be used on both large and small chambers produced by the same special extrusion process. Author

N86-29963# Naval Postgraduate School, Monterey, Calif.
MICROSTRUCTURAL FORMATION AND EFFECTS ON THE PERFORMANCE OF PLATINUM MODIFIED ALUMINIDE COATINGS Final Report, 1981 - 1985
P. Deb and D. H. Boone Nov. 1985 66 p
(AD-A166166; NPS69-85-008) Avail: NTIS HC A04/MF A01 CSCL 11/3

The use of noble metal modified aluminide coatings has gained renewed interest as the requirements of improved protectivity for gas turbine engine components has increased. Increasing temperature, severity of operating environment and required lifetime extension are cited as reasons for their selection. While the literature documents examples of significant improvements in hot corrosion resistance at low (800 C) and high (800 C) temperatures and in cyclic oxidation with Pt additions, there are also examples of limited improvements and even detrimental effects. These controversies have been preliminarily ascribed to the considerable differences in microstructural features possible in these systems and to the variation in test procedures between laboratories, and between rigs and engines. A systematic study was therefore initiated to identify the microstructural variations obtained for platinum-modified aluminide coatings on IN738 and to develop a fundamental understanding of their mechanism of formation. In this final report, the several classical structural types are defined together with the beginnings of their formation understanding. These microstructures were then subjects to a series of tests under conditions including hot corrosion at 700 and 900 C, and cyclic oxidation. In addition, measurements of mechanical properties such as DBTT were performed. It was found tha platinum addition to a standard aluminate is beneficial at 900 C, so far as hot corrosion attack is concerned. GRA

N86-29964# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME TENTATIVE IDEAS ON DEVELOPING OUR LOW-ALLOY AND ALLOY STEEL
Chuandian Zhou 14 Mar. 1986 25 p Transl. into ENGLISH from Gangtie (China), no. 7, 1983 p 1-8
(AD-A166269; FTD-ID(RS)T-0929-85) Avail: NTIS HC A02/MF A01 CSCL 11/6

The decision that every effort will be made to develop low-alloy and alloy steel made by the State Council has great strategic significance; it shows that our steel industry is shifting its emphasis to quality control and increasing economic profits, especially benefiting society. Compared with ordinary carbon steel, low-alloy and alloy steel are qualitatively better and economically more profitable. GRA

N86-29965# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
THE DEVELOPMENT OF ALADIN (ALUMINUM ALLOY DESIGN INVENTOR), AN EXPERT SYSTEM FOR ALUMINUM ALLOY DESIGN Interim Report
Martha L. Farinacci, Mark S. Fox, Ingemar Hulthage, and Michael D. Rychener Jan. 1986 19 p
(AD-A166278; CMU-RI-TR-86-5) Avail: NTIS HC A02/MF A01 CSCL 11/6

ALADIN is an expert system that aids metallurgists in the design of new aluminum alloys. The project began in January 1984, and two major iterations of the system design have been completed. The current system is a hybrid of several approaches and artificial intelligence techniques. Declarative representations are used for metallurgical data and concepts. The basic design procedure is rule-based, with the potential for flexible control and participation by the user. The system is based on the hypothesize-and-test model, and a constraint-based search is used to find alternative designs. Strategies are included for resolving the interactions and trade-offs among conflicting property targets. Metallurgical relationships cover a broad range of symbolic and numerical types of reasoning, which are integrated in the system. In this article, an overview of the project is given, including discussions of knowledge acquisition techniques, design decisions and implementation. GRA

N86-29966# Michigan State Univ., East Lansing. Dept. of Metallurgy Mechanics and Materials Sciences.
INHIBITING CORROSION CRACKING: CRACK TIP CHEMISTRY AND PHYSICS Final Report, 1 Apr. 1984 - 14 Mar. 1986
Robert Summitt 14 Mar. 1986 36 p
(Contract N00014-84-K-0419)
(AD-A166317) Avail: NTIS HC A03/MF A01 CSCL 11/6

Aqueous metallic corrosion is a complex process involving a variety of individual steps in the overall mechanism for a given alloy. The problems of pitting corrosion, crevice corrosion, stress corrosion cracking (SCC), and corrosion fatigue (CF) are, to say the least, significantly more complex. If the discussion is extended further to include the action of substances which either accelerate or inhibit these processes, the complexity of the problems is increased further by orders of magnitude. The subject of the research program discussed in this report is an experimental exploration of the relations between accelerant/inhibitor properties and the electrochemistry and electrokinetics of corrosion, SCC, and CF in aluminum alloys. Experimental microtechniques are used to determine physical and chemical conditions at a corrosion crack tip while the bulk exterior environment is modified by the presence of corrosion accelerants or inhibitors. The chemistry of the

nitrogen-system inhibitors is being explored systematically to identify accelerant/inhibitor characteristics which are effectiv e in determining corrosion crack growth rates, thereby leading to practical inhibitor formulations. GRA

N86-29967# Naval Research Lab., Washington, D. C.
A LITERATURE REVIEW ON THE INFLUENCE OF SMALL-AMPLITUDE CYCLIC LOADING ON STRESS-CORROSION CRACKING IN ALLOYS
T. W. Crooker and J. A. Hauser, II 3 Apr. 1986 20 p
(AD-A166403; AD-E950826; NRL-MR-5763) Avail: NTIS HC A02/MF A01 CSCL 11/6

Stress-corrosion cracking (SCC) is a cracking process caused by the conjoint action of stress and a corrodent. Traditionally, the stress that causes SCC has been regarded as a sustained tensile stress. When corrosion-assisted cracking is caused by cyclic stress, the problem is termed corrosion fatigue. Thus, test methods for SCC rely upon static (or quasi-static) tensile loading. However, in recent years researchers have developed new information showing that, at least in certain instances, small-amplitude cyclic loading superimposed on high tensile loads (ripple-loading) can have a significant influence on SCC behavior. The trend revealed is that ripple-loading reduces the apparent SCC stress or stress-intensity threshold and accelerates time-to-failure for stresses or stress-intensities above threshold levels. The implication of these findings is that traditional static tests for SCC may, in fact, be non-conservative. The mechanism of ripple-load cracking is thought to involve film rupture at active SCC sites. The recent literature on ripple-loading has been identified and reviewed . Several notable examples have been cited and discussed. Directions for further study are delineated. Author (GRA)

N86-29968# California Univ., Berkeley. Dept. of Materials Science and Engineering.
FATIGUE BEHAVIOR OF LONG AND SHORT CRACKS IN WROUGHT AND POWDER ALUMINUM ALLOYS Research Progress and Forecast Report, 15 Apr. - 15 Nov. 1985
Robert O. Ritchie 15 Nov. 1985 4 p
(Grant AF-AFOSR-0181-82)
(AD-A166466; AFOSR-86-0088TR) Avail: NTIS HC A02/MF A01 CSCL 11/6

The fatigue behavior of short cracks, which are small compared to the scale of the microstructure, small compared to the scale of local plasticity or simply physically small (i.e., approx. 1 mm), must be considered as one of the major factors limiting the application of defect-tolerant fatigue design for airframe and engine components. Accordingly, the current program is aimed at identifying factors which govern the growth of such short cracks (in contrast to long cracks) in a series of commercial aluminum alloys, with specific reference to behavior at near-threshold levels (below approx. 0.100000 mm/cycle). A summary of the research performed during the past six months is described, together with a review of future work. GRA

N86-29969# Knolls Atomic Power Lab., Schenectady, N. Y.
MECHANISM OF STRESS-CORROSION CRACKING OF ALLOY X-750 IN HIGH PURITY WATER
C. A. Grove and L. D. Petzold Nov. 1985 40 p Presented at the ASM International Conference on Corrosion of Nickel Base Alloys, Cincinnati, Ohio, 2-3 Oct. 1984
(Contract DE-AC12-76SN-00052)
(DE86-006361; KAPL-4186; CONF-8410208-3) Avail: NTIS HC A03/MF A01

The high strength Ni-base Alloy X-750 is susceptible to stress-corrosion cracking (SCC) in high purity, deaerated water. Crack initiation occurs at high temperatures (>400 F). Crack propagation occurs in both high-temperature and low-temperature (<300 F) water. High-temperature crack growth rates are on the order of mils/day. Low-temperature cracking is extremely rapid (approx.100 in./day). Three heat treatments of Alloy X-750 are investigated: (1) Stress Equalized - 1625 F/24 hr + 1300 F/20 hr, (2) Direct Aged - 1300 F/24 hr, and (3) Solution Annealed and Direct Aged - 2000 F/1 hr + 1300 F/20 hr. Stress-equalized Alloy X-750 is most susceptible to SCC; solution-annealed and direct-aged Alloy X-750 is least susceptible. A Hydrogen Embrittlement Model of SCC is developed that predicts SCC performance on the basis of grain boundary chemistry and grain boundary carbides. Phosphorus segregates to the grain boundary in concentrations of up to approx.100 times the bulk concentration during processing and heat treatment. Phosphorus at the grain boundaries increases susceptibility to high- and low-temperature SCC. The presence of M23C6-type carbides and/or the absence of MC-type carbides at the grain boundaries improves SCC performance in high-temperature water. DOE

N86-29970# Argonne National Lab., Ill.
PRODUCTION AND PROPERTIES OF METALLIC SUPERLATTICES
I. K. Schuller Oct. 1985 5 p Presented at the National Congress of the French Physical Society, Nice, France, 9 Sep. 1985
(Contract W-31-109-eng-38)
(DE86-003058; CONF-8509237-1) Avail: NTIS HC A02/MF A01

Considerable interest has been generated by the recent observation of large anomalies in the elastic, magnetic, superconducting, and structural properties of metallic superlattices. This paper summarizes part of our work on the preparation, characterization, and physical properties (mostly superconductivity) of metallic superlattices of combinations that do not form solid solutions in their equilibrium binary phase diagrams. Metallic superlattices with accurate control over their structure can be prepared using sputtering and molecular beam epitaxy (MBE) techniques. The magnetic, elastic and superconducting properties show unusual behavior which can be controlled by changing preparation conditions. DOE

N86-29971# State Univ. of New York, Stony Brook.
THEORETICAL STUDIES OF CHEMISORPTION ON COPPER NICKEL ALLOYS AND SURFACE EMBRITTLEMENT Progress Report, 15 Jun. 1985 - 14 Jun. 1986
J. L. Whitten 15 Feb. 1986 8 p
(Contract DE-FG02-84ER-45100)
(DE86-007034; DOE/ER-45100/2) Avail: NTIS HC A02/MF A01

The current research is part of a theoretical program to study the structure and energetics of molecules adsorbed on solid surfaces, with emphasis on transition metal substrates. During the past year, the research effort can be divided into several categories: application of the embedding theory to nickel and titanium systems, further development of the theoretical techniques including some very promising recent work on simplifications, and several miscellaneous treatments of molecular excited states. DOE

N86-29972# Sandia National Labs., Albuquerque, N. Mex.
SOLIDIFICATION DYNAMICS AND MICROSTRUCTURE OF METALS IN PULSED LASER IRRADIATION
P. S. Peercy 1985 40 p Presented at the NATO Advanced Study Inst. on Laser Surface Treatment of Metals, San Miniato, Italy, 2 Sep. 1985
(Contract DE-AC04-76DP-00789)
(DE86-002169; SAND-85-1350C; CONF-8509150-3) Avail: NTIS HC A03/MF A01

There is an important and growing technology in laser processing of metals. The more well-developed aspects of this technology include applications such as cutting, maching, welding, surface hardening, surface alloying, etc. These applications use primarily high power cw lasers. In contrast, the technology for pulsed laser - metal interactions for laser pulse widths in the nanosecond, or shorter, time regime is not as well-developed; however, studies in this time regime are providing important insight into the processes that control metastable and amorphous phase formation of importance for certain applications. Selected activities in this area are reviewed in this paper with emphasis on al-based alloys. When appropriate, system produced by pulsed surface melting are compared to related systems produced by ion implantation. DOE

N86-29973# Wisconsin Univ., Madison.
NUCLEATION OF ALLOTROPIC PHASES DURING PULSED LASER ANNEALING OF MANGANESE
J. H. Perepezko, D. M. Follstaedt, and P. S. Peercy 1985 7 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE86-004584; SAND-85-1292C; CONF-851217-44) Avail: NTIS HC A02/MF A01

Manganese has four allotropes with an equilibrium melting point of the high temperaure delta-phase at 1517 K and calculated metastable melting points for the (GAMMA), (BETA), and (ALPHA) phases at 1501, 1481, and 1395 K, respectively. Our observations for Mn irradiated with a pulsed laser and supporting estimates of maximum allotropic transition rates indicate that transformations between allotropes are suppressed during heating with approximately 25 ns laser pulses, as well as during subsequent cooling. Upon pulsed heating of (ALPHA)-Mn to the melt threshold, the melt is undercooled 122 K below the delta-Mn melting point. For incident laser pulse energy densities near the melting threshold, resolidification involves regrowth of (ALPHA)-Mn from the substrate. At energy densities well above the threshold, the (GAMMA)-Mn phase forms by separate nucleation and growth from the undercooled melt, and is retained upon rapid solidification. We conclude that significant melt undercooling, which may exceed 100 K, can occur during pulsed laser melting of metallic crystals and that the resulting crystalline structure is determined by both thermodynamics and nucleation kinetics. DOE

N86-29974# Pacific Northwest Lab., Richland, Wash.
THEORY OF AMORPHIZATION KINETICS IN INTERMETALLICS
E. P. Simonen Oct. 1985 21 p Presented at the ASM Metals Congress/TMS-AIME Fall Meeting, Toronto, Ontario, 13 Oct. 1985
(Contract DE-AC06-76RL-01830)
(DE86-004858; PNL-SA-13169; CONF-8510160-13) Avail: NTIS HC A02/MF A01

An examination of amorphization kinetics in intermetallic alloys indicated that both a model based on cascade-induced point defects and a model based on a uniform production of point defects rationalized observed amorphization kinetics in ion irradiated NiTi. The dose dependencies of average defect concentrations were calculated and the fluctuations in concentration were simulated using a Monte Carlo technique. Assumed low interstitial mobilities and high sink strengths promoted amorphization. Faster interstitial mobilities caused shorter lifetime for cascades and lesser accumulation of cascade damage. Assuming uniform production of point defects, the predicted dose exponent for amorphization increased with increasing critical defect concentration and increasing critical cluster size. DOE

N86-29975# Kuo and Associates, McLean, Va.
MICROALLOYED NICKEL-3/ALUMINUM, A NEW MEDIUM TEMPERATURE ALLOY
1986 5 p
(Contract DE-AC01-85ER-30078)
(DE86-006227; DOE/ER-30078/T1) Avail: NTIS HC A02/MF A01

ORNL conducted a research project in 1981, sponsored as part of the DOE Seed Money Program, to create microalloys of nickel-3/aluminum and study their properties. The response of industry has included inquiries from more than 20 firms expressing interest in obtaining licensing rights for the ORNL developed microalloy of nickel-3/aluminum. ORNL has recently signed a license agreement with the Cummins Engine Company for an exclusive license to use the alloy in heavy duty diesel engine parts. Information has been provided to virtually every major supplier of nickel-based materials, specialty steel, heat exchanger tubes, producers of aircraft engines, major tool and diemakers, and manufacturers of fasteners and molds. Nickel-3/aluminum microalloys are expected to gradually be used in many medium temperature applications (diesel engines, turbochargers, gas turbines, welded tubing, fasteners, castings, etc.). DOE

N86-29976# California Univ., Berkeley. Lawrence Berkeley Lab.
CRYOGENIC MECHANICAL PROPERTIES OF Al-Cu-Li-Zr ALLOY 2090
J. Glazer, S. L. Verzasconi, E. N.C. Dalder, W. Yu, R. A. Emigh, R. O. Ritchie, and J. W. Morris, Jr. Aug. 1985 17 p Presented at the Cryogenic Engineering Conference and International Cryogenic Materials Conference, Boston, Mass., 12 Aug. 1985 Prepared in cooperation with Lawrence Livermore National Lab., CA.
(Contract DE-AC03-76SF-00098)
(DE86-006285; LBL-19232; CONF-850814-36) Avail: NTIS HC A02/MF A01

The mechanical properties of aluminum-lithium alloy 2090- T8E41 were evaluated at 298(0)K, 77(0)K, and 4(0)K. Previously reported tensile and fracture toughness properties at room temperature were confirmed. This alloy exhibits substantially improved properties at cryogenic temperatures; the strength, elongation, fracture toughness and fatigue crack growth resistance all improve simultaneously as the testing temperature decreases. This alloy has cryogenic properties superior to those of aluminum alloys currently used for cryogenic applications. DOE

N86-29977# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
COMPUTER SIMULATIONS OF THE STRUCTURE AND PROPERTIES OF GRAIN BOUNDARY DISLOCATIONS
P. D. Bristowe Oct. 1985 12 p
(Contract DE-FG02-84ER-45116)
(DE86-007005; DOE/ER-45116/10) Avail: NTIS HC A02/MF A01

The core structure of intrinsic grain boundary dislocations embedded in twist grain boundaries has been modelled using conventional atomistic techniques and a variety of empirical and pseudo-potentials representing fcc metals. In particular the width of the dislocation core region in the boundary plane has been studied as a function of the periodicity of the boundary (SIGMA) and interatomic potential. Generally, the core width increases with increasing (SIGMA) and is wider than that of lattice dislocations. Also the core width of twist grain boundary dislocations can be wider than that of tilt grain boundary dislocations. The presence of resolvable cusps on the computed energy/misorientation curve is related to the degree of core localization and the formation of domains of relatively low energy structure. The results are compared to transmission electron microscope observations, previous calculations, and the structural unit/grain boundary dislocation model. DOE

N86-29978# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
INVESTIGATIONS OF CREEP CAVITATION IN TYPE 304 STAINLESS STEEL Progress Report, 7 Jan. 1985 - 6 Jan. 1986
T. J. Delph, R. J. Fields, and D. G. Harlow 1986 140 p
(Contract DE-FG02-84ER-45088)
(DE86-007187; DOE/ER-45088/2) Avail: NTIS HC A07/MF A01

The focus of the investigation is upon creep cavitation in metals with particular emphasis upon AISI type 304 stainless steel. The investigation consists of both experimental and analytical phases. Work in the experimental phase of the investigation is concentrated upon image analyzing computer measurements of cavitation under conditions of uniaxial and multiaxial stress. The analytical portion of the investigation involved two efforts: the first of these is the development of a nonlinear finite element code which will allow the prediction of the time-varying stress and deformation fields in specimens with complex biaxial states of stress. The second effort, which is now essentially complete, involves the micromechanical modeling of probabilistic effects in creep cavitation. DOE

N86-29979# Knolls Atomic Power Lab., Schenectady, N. Y.
MICROSTRUCTURE EFFECTS ON ION AND ELECTRON TRANS-

PORT PARAMETERS DURING PASSIVE CORROSION OF ZIRCALOY
P. Baldasaro Feb. 1986 31 p
(Contract DE-AC12-76SN-00052)
(DE86-007189; KAPL-4188) Avail: NTIS HC A03/MF A01

Analytical models have been developed and numerical predictions have been made to quantify the effect of zirconia microstructure (grain boundary and microcrack network) on ion and electron transport parameters. Analytical predictions are shown to agree with the available data, supporting a large microstructure effect on ion diffusion and a small effect on electron mobility. Results of this analysis have been interpreted in terms of the zircaloy corrosion process to conclude: (1) the transition process predominantly affects ion transport resistance and has relatively little effect on electron transport and (2) medium penetration into the zirconia film during transition is not necessary to initiate loss of corrosion protection. DOE

N86-29980# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
PHASE TRANSFORMATIONS IN NICKEL-ALUMINUM ALLOYS DURING ION BEAM MIXING
J. Eridon, L. Rehn, and G. Was Jan. 1986 8 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE86-007519; CONF-851217-55) Avail: NTIS HC A02/MF A01

The effect of ion beam mixing of nickel-aluminum alloys with 500 keV krypton ions has been investigated over a range of temperature, composition, ion dose, and post-irradiation thermal treatments. Samples were formed by alternate evaporation of layers of aluminum and nickel. A portion of these samples was subsequently annealed to form intermetallic compounds. Irradiations were performed at both room temperature and 80K using the 2MV ion accelerator at Argonne National Laboratory. Phase transformations were observed during both in situ irradiations in the High Voltage Electron Microscope (HVEM) at Argonne, and also in subsequent analysis of an array of irradiated samples. Electron diffraction indicates the presence of metastable crystalline structures not present in the conventional nickel-aluminum phase diagram. Transformations occur at doses as low as 5 x 10(14) cm(-2) and continue to develop as the irradiation progresses up to 2 x 10(16) cm(-2). Layer mixing is followed through Rutherford Backscattering analysis. Samples are also checked with x-rays and Electron Energy Loss Spec troscopy (EELS). A thermodynamic argument is presented to explain the phase transformations in terms of movements on a free energy diagram. This analysis explains the interesting paradox concerning the radiation hardness of the NiAl phase and the amorphous structure of mixed Ni-50% Al layers. DOE

N86-29981# Idaho National Engineering Lab., Idaho Falls.
USE OF MINIATURIZED TESTS TO PREDICT FLOW PROPERTIES AND ESTIMATE FRACTURE TOUGHNESS IN DEFORMED STEEL PLATES
F. M. Haggag, W. L. Server, G. E. Lucas, and G. R. Odette 1985 20 p Presented at the International Conference and Exhibition on Fatigue, Corrosion Cracking, Fracture Mechanic and Failure Analysis, Salt Lake City, Utah, 2 Dec. 1985 Prepared in cooperation with California Univ., Santa Barbara.
(Contract DE-AC07-76ID-01570)
(DE86-007644; EGG-M-05285; CONF-851203-4) Avail: NTIS HC A02/MF A01

Prediction of instability in a structure requires knowledge of the mechanical properties of the materials involved. In the case of serious accidents, such as derailments of railroad tank cars carrying hazardous materials, prediction of instability in damaged components is difficult due to insufficient knowledge of: the deformed material fracture toughness, the cracks induced by the accident, and the stress state in the damaged region. This paper evaluates the fracture toughness problem. Miniaturized shear punch tests on virgin, strained, and deformed steel plates (typical of railroad tank car construction) were conducted over a wide range of test temperatures. These data were compared with tensile measurements on identical materials. The use of these data coupled with micro-mechanical models of fracture allows estimation of the deformed material fracture toughness. Comparisons of the predicted fracture toughness with actual measurements are made. DOE

N86-29982# Northwestern Univ., Evanston, Ill. Dept. of Physics and Astronomy.
LOCAL DENSITY THEORY OF HEATS OF FORMATION AND SHORT-RANGE ORDER PARAMETERS IN SUBSTITUTIONALLY DISORDERED ALLOYS Progress Report
A. J. Freeman and A. Gonis 1986 6 p
(Contract DE-FG02-84ER-45080)
(DE86-007979; DOE/ER-45080/T2) Avail: NTIS HC A02/MF A01

Purpose of this project is the study and the calculation of polyatomic interactions in substitutionally disordered alloys, with the ultimate goal the calculation of alloy phase diagrams from first principles. Of particular importance in these calculations are the heats of formation, (DELTA)H, of substitutionally disordered alloys, the short-range-order (SRO) parameters, P/sub ij//sup (ALPHA)(BETA)/, giving the probability of obtaining simultaneously a configuration consisting of atoms of type (ALPHA) and (BETA) on sites i and j, respectively, and the polyatomic interactions, i.e., irreducible energy contributions associated with configurations consisting of atoms of types (ALPHA),(BETA),...(GAMMA), at sites, i,j...k, respectively. DOE

N86-29983# Pacific Northwest Lab., Richland, Wash.
MICROSTRUCTURE, MICROCHEMISTRY, AND MICRODEFORMATION OF ALLOY 600 TUBING Final Report
S. M. Bruemmer, L. A. Charlot, and C. H. Henager, Jr. Feb. 1986 55 p
(Contract DE-AC06-76RL-01830)
(DE86-007947; EPRI-NP-4465) Avail: NTIS (US Sales Only) HC A04/MF A01

Using microanalytic techniques, scientists have found grain-boundary carbides to be the source of dislocations during deformation of alloy 600 tubing. The higher density of grain-boundary carbides in thermally treated tubing compared with mill-annealed tubing appears to have a controlling effect on intergranular stress corrosion cracking (IGSCC) in primary water. DOE

N86-29984# Paris-Sud Univ., Orsay (France). Lab. de Physique des Gaz et des Plasmas.
PLASMA NITRIDING OF METALLIC SURFACES [NITRURATION PAR PLASMA DE SURFACE METALLIQUES]
J. L. Marchand, H. Michel, and A. Ricard Nov. 1985 20 p In FRENCH
(LP-211; ESA-86-97186) Avail: NTIS HC A02/MF A01

The length of the electric discharge was studied in nitriding using an H2/N2 gas mixture at a given flow and adjustable voltage and intensity of the electric discharge. The electrical variables were chosen to keep the specimen temperature at 550 C. The vibrational energy distribution observed in the N2 spectrum is given. An increased concentration of the first level population is found in the case of a longer discharge. The finding is well correlated with the specimen analysis. The X-ray diffraction shows a clear increase of nitriding for the longer discharge. ESA

N86-29985# Kernforschungsanlage, Juelich (West Germany). Zentralinst. fuer Angewandte Mathematik.
THE CALCULATION OF HYDROGEN DIFFUSION THROUGH METAL MEMBRANES
M. Profant, R. vonSeggern, P. Wienhold, and E. Horlitz Dec. 1985 57 p In GERMAN; ENGLISH summary
(JUEL-2029; ISSN-0366-0885; ESA-86-97424) Avail: NTIS HC A04/MF A01

The computer program PERM was developed to calculate the solution of the one-dimensional diffusion equation with quadratic boundary conditions. The knowledge of this function is important

for the estimation of the hydrogen content and the tritium inventory of fusion devices. The diffusion equation was transformed into a dimensionless form for numerical treatment. The transformed wall thickness L which is identical to the permeation number is the only physical parameter of the problem. The common difference methods fail at the beginning of the computation because of the large range of L (between 10 to the minus 5th power and 10 billion) and the incompatibility of the boundary conditions with the initial condition. A variant of the boundary integral method was derived using the Laplace transformation. By this method the solution of the diffusion equation can be calculated with selected accuracy in the whole range of the parameter L. The main difficulties in implementing this method are due to the discretization of convolution integrals over space and time which contain Jacobi's Theta function. ESA

N86-29986# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
CORROSION OF VANADIUM AND THE ALLOY V 3TI 1SI IN FLOWING LITHIUM Thesis - Karlsruhe Univ., West Germany
J. Konys Jan. 1986 221 p In GERMAN; ENGLISH summary
(KfK-4006; ESA-86-97425) Avail: NTIS HC A10/MF A01

The corrosion behavior of V3TI 1Si in flowing lithium was studied in a pumped lithium loop fabricated from a titanium-stabilized type 316 steel. Pure vanadium was used as a reference material. At temperatures of 823K, experiments were performed without any problems over a duration of more than 7500 hr. The influence of a magnetic traps incorporated just before the flowmeter to avoid the precipitation of magnetic particles was investigated; it reduces significantly the weight loss of V in the alloy, probably due to the reduction of the nitrogen content of Li. The corrosion rate of V is 14 microm/year, independently of the N-content of Li. The corrosion rate of V 3TI 1SI is as low as 4 microm/year depending on the N-concentration of Li. Both V and V3 Ti 1Si pickup more N than C from Li; pure V twice as much N than the alloy. Nitrogen diffuses into the bulk of both materials, while C is bound near the surface; the hardening at the surface is due to the imbedded N. The vanadium-carbon nitride and the vanadium-titanium nitride-layers, respectively have a strong effect on the weight loss and the uptake to nonmetals. The results show that the dissolution due to V-loss does not affect alloy lifetime. nd the uptake to nonmetals. The results show that the dissolution due to V-loss does not affect alloy lifetime. ESA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N86-29987 British Library Lending Div., Boston Spa (England).
INCREASE OF LIFE OF THREADED JOINTS OF TUBE COUPLINGS IN OIL PIPELINE RANGE THROUGH USE OF ANTICORROSION COATINGS
M. A. Losukarev, I. A. Filippova, L. L. Belikova, I. A. Sukhomlin, A. V. Mombelli, and A. S. Koshevoi 1985 6 p Transl. into ENGLISH from Iz. (USSR), no. 10, 1985 p 86-88
(BLL-M-36718-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

The zinc phosphate and manganese phosphate solutions suggested by the authors bestow a high protective capacity on the resultant films, which enables them to be used effectively for protection of the threaded joints of tubes in the oil-extraction range. Agitating the solutions during phosphating considerably enhances the anticorrosion properties of the resultant phosphate films. Author

N86-29988*# National Aeronautics and Space Administration, Washington, D.C.
RELATION BETWEEN MICROSTRUCTURAL HETEROGENEOUS SURFACE LAYER AND NITROGEN PRESSURE DURING SINTERING IN Si3N4-VgO-Al2O3 CERAMICS
K. Hayashi and Y. Onomura Apr. 1986 18 p Transl. into ENGLISH from Journal of the Japan Society of Powder and Powder Metallurgy (Japan), v. 32, no. 5, Jul. 1985 p 200-204 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88409; NAS 1.15:88409) Avail: NTIS HC A02/MF A01 CSCL 11B

The effects of N2 pressure (0.1 to 50 MPa) during sintering on the thickness of the microstructurally heterogeneous layer (MHL) formed near the surface of the compact, transverse-rupture strength, were investigated for Si3N4-(10 to 20) mol % MgO-5.5 mol % Al2O3 ceramics. The sintering temperature and time were 1973 K and 3.6 ks, respectively. The N2 gas was introduced into the furnace at about 1273 K. When the compacts were sintered under a certain N2 pressure, for example, about 20 and 7 MPa for 10 and 15 mol% MgO, respectively, the evolutions of N and Si were suppressed. The thickness of the MHL became very small and at the same time the strength of the surface layer of the compact (which was normally less than that of the inside in the case of 0.1 MPa) became nearly the same value as that of the inside. At higher pressure, the strength of both surface layer and the inside decreased considerably. Some discussion was made on these results. Author

N86-29989*# Boeing Aerospace Co., Seattle, Wash.
DEVELOPMENT OF COMPOSITE TUBE PROTECTIVE COATINGS Final Report
H. Dursch and C. Hendricks Jul. 1986 109 p
(Contract NAS1-16854)
(NASA-CR-178116; NAS 1.26:178116; D180-29767-1) Avail: NTIS HC A06/MF A01 CSCL 11G

Protective coatings for graphite/epoxy (Gr/Ep) tubular structures proposed for the Space Station are evaluated. The program was divided into four parts; System Definition, Coating Concept Selection and Evaluation, Scale-up and Assembly, and Reporting. System Definition involved defining the structural and environmental properties required of the Gr/Ep tubes. The prepreg and ply sequence selected was a P75S/934 (O2, + or - 20, O2)sub s layup which meets the various structural requirements of the Space Station. Coating Concept and Selection comprised the main emphasis of the effort. Concepts for protectively coating the Gr/Ep tubes included the use of metal foil and electroplating. The program results demonstrated that both phosphoric and chromic acid anodized Al foil provided adequate adhesion to the Gr/Ep tubes and stability of optical properties when subjected to atomic oxygen and thermal cycling representative of the LEO environment. SiO2/Al coatings sputtered onto Al foils also resulted in an excellent protective coating. The electroplated Ni possessed unacceptable adhesion loss to the Gr/Ep tubes during atomic oxygen testing. Scale-Up and Assembly involved fabricating and wrapping 8-ft-long by 2-in-diameter Gr/EP tubes with chromic acid anodized foil and delivering these tubes, along with representative Space Station erectable end fittings, to NASA LaRC. Author

N86-29990# University of Southern California, Los Angeles.
CHEMISTRY OF NEW SILICON CONTAINING POLYMERS TRIPLY BONDED SILICON INTERMEDIATES Final Report, 31 Aug. 1982 - 31 Oct. 1985
William P. Weber Dec. 1985 11 p
(Grant AF-AFOSR-0333-82)
(AD-A166085; AFOSR-86-0131TR) Avail: NTIS HC A02/MF A01 CSCL 07/3

A method to generate (O=Si=O) in the gas phase by flash vacuum pyrolysis (FVP) of 2,3:4,7 diepoxy 5-silaspiro (4.4) nonane was developed. Reactive pi-bonded silicon nitrogen double bonds intermediates were generated by FVP of dimethoxymethylsilyl-bis (trimethylsilyl) amine. Photolysis of dodecamethylcyclohexasilane yields both dimethylsilylene and methylsilene. The oxidation of dimethylsilylene with sulfoxides yields silanones. Sterically bindered T-butyldimethyl-silaned permits control in the silyl hydroformylation reaction. GRA

N86-29991# Pennsylvania Univ., Philadelphia. Center for Chemical Electronics.
SPIN-COATED AMORPHOUS CHALCOGENIDE RESISTS SPIN-COATED AMORPHOUS CHALCOGENIDE GLASSES Final Report, 29 Jul. 1981 - 29 Nov. 1984
I. Lauks, S. Rabii, J. J. Santiago, and J. N. Zemel 24 Dec. 1985 73 p
(Grants AF-AFOSR-0320-84; AF-AFOSR-0201-81)
(AD-A166270; AFOSR-86-0079TR) Avail: NTIS HC A04/MF A01 CSCL 09/1

Amorphous films of several chalcogenides were spin-cast from solutions prepared by dissolving the starting material in organic solvents. As-deposited materials were identified as amine and amide salts. A mechanism was proposed for the dissolution of arsenic trisulfide in the organic solvent as maromolecular clusters. Thermal annealing to 200 C of arsenic trisulfide solution-cast material showed decomposition of the organic salt about 90 C followed by cross-linking of arsenic sulfide clusters above 130 C. Technologically utile, quality thin films were obtained with spin deposited arsenic trisulfides. Pattern replication using ultra-violet photodoping by silver was demonstrated and a scheme for high resolution lithography was proposed. The 0.4 micrometer wide patterns over 1 micrometer topography were replicated without dimensional loss. Multilayer films of up to 4.5 micrometers were obtained for optical measurements by several consecutive spinning-baking sequence, without reduction in flatness. The mean value of the index of refraction and optical band gap were 2.227 + or - 0.055 and 2.273 + or - 0.024 eV respectively. Electronic structure of As4S4 and As4Se4 molecules were calculated and the resulting molecular band gaps were consistent with the measure value for the corresponding glasses. The calculated density-of-valence-states for the molecules were of very good agreement with valence band XPS measurement on the solids. GRA

N86-29992# Southwest Research Inst., San Antonio, Tex. Div. of Engineering and Materials Science.
STUDY OF TEST METHODS FOR URETHANE ELASTOMERS Interim Report
J. J. Dziuk, Jr., W. A. McMahon, C. H. Parr, W. A. Mallow, and H. S. Silvus 18 Oct. 1985 90 p
(Contract DAAK70-85-C-0007)
(AD-A166293; BFLRF-204) Avail: NTIS HC A05/MF A01 CSCL 11/10

The feasibility of using a portable instrument to determine the physical condition of fabric-reinforced polyurethane fuel tanks was studied during this project. The condition of the polyurethane was determined by measuring its surface electrical resistivity. Electrical resistivity of a polymer will change as it ages or deteriorates. An instrument designed and built by Southwest Research Institute personnel was found to be effective in determining the relative surface resistivity of polyurethane. This instrument was able to measure the surface resistivity of polyurethane samples in varying degrees of degradation due to aging. GRA

N86-29993# Akron Univ., Ohio. Inst. of Polymer Science.
THE INFLUENCE OF CHEMICAL STRUCTURE ON THE STRENGTH OF RUBBER
A. N. Gent Apr. 1986 24 p
(Contract N00014-85-K-0222)
(AD-A166355; TR-4) Avail: NTIS HC A02/MF A01 CSCL 11/10

The detailed chemical structure of the polymer molecule has surprisingly little effect upon many of the important physical properties of crosslinked elastomers. For example, the elastic modulus, extensibility, tensile strength and tear strength are all much the same for many common elastomers. However, the strength of elastomers under some conditions is strikingly different. Two particular modes of fracture are considered here: tearing, and abrasive wear. Certain elastomers crystallize rapidly on stretching and become self-reinforcing, so that their tear strength is greatly enhanced. Factors that govern the speed of strain-induced crystallization are reviewed. In abrasive wear, the macroradicals generated by molecular rupture are highly reactive and their reactions affect both the nature and the extent of wear. The wear processes that occur in various reinforced elastomers are described and compared. GRA

N86-29994# Akron Univ., Ohio. Inst. of Polymer Science.
ELASTICITY, TEAR STRENGTH AND STRENGTH OF ADHESION OF SOFT PVC GELS
A. N. Gent and N. Shimizu Apr. 1986 42 p
(Contract N00014-85-K-0222)
(AD-A166356; TR-6) Avail: NTIS HC A03/MF A01 CSCL 11/9

An experimental study is described of the tensile modulus E of elasticity, tear strength G sub c and strength G sub a of adhesion of a Mylar substrate, for polyvinyl chloride (PVC) gels prepared with a wide range of PVC concentrations and with four different plasticizers. The modulus E, measured under quasi-equilibrium conditions, was found to be approximately proportional to C superscript 3, where c is the volume concentration of PVC. The tensile behavior suggests that the molecular strands comprising the undiluted elastic network are relatively short, only about 26 C atoms long. G sub c under threshold conditions was found to vary with C superscript 2.25 and to be considerably larger than (about 10X), the value expected for a molecular network of short PVC chains. This difference is attributed to yielding of crystallites before molecular rupture can take place. Adhesion to Mylar of PVC gels was relatively weak. Both the tear strength and strength of adhesion were strongly dependent upon rate of fracture propagation and upon temperature, in good accord with the WLF rate-temperature equivalence for simpl e glass-forming substances. Thus, the strength of PVC gels appears to be determined largely by the glass temperature of the composition, and not by the amount or type of plasticizer except insofar as they affect the glass temperature. GRA

N86-29995# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
CHALCOGENIDE GLASSES. PART 2: OPTICAL THICKNESS TEMPERATURE RELATION IN CHALCOGENIDE GLASS FILMS Final Report, 1 Oct. 1983 - 30 Sep. 1984
Koto White, Conrad M. Phillippi, and Laura S. Rea Feb. 1986 28 p
(AD-A166589; AFWAL-TR-85-4092-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 20/6

The optical thickness, which is a multiplication of the refractive index and the physical thickness of a film, is the most important parameter in designing a spectral interference filter. This quantity should be stable against all environmental effects, particularly the heating effect. The changes in optical thickness due to heating may be divided into two categories; a reversible change and irreversible change. This report describes the reversible portion of changes in refractive index, film thickness and optical thickness with temperature, caused by temperature coefficient of refractive index and thermal expansion coefficient of chalcogenide glass films. Film compositions studied were; As2S3, As3S7, AsS4, Ge3S7, and Ge5As38S57. This report also describes the spectro-photometric technique utilized to determine the optical parameters. GRA

N86-29996# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
CHALCOGENIDE GLASSES. PART 3: CHALCOGENIDE GLASS-FORMING SYSTEMS Final Report, 1 Oct. 1982 - 30 Sep. 1984
Koto White Feb. 1986 78 p
(AD-A166592; AFWAL-TR-85-4122-Pt-3) Avail: NTIS HC A05/MF A01 CSCL 20/6

This report summarizes the literature search on glass-forming regions of chalcogenide compositional systems. Brief discussions on physical, chemical and structural properties are also included. This study was conducted to select and evaluate the chalcogenide glasses which are suitable for use in graded optical filter applications. Continuous variations of optical properties may be achieved by continuously varying the compositions of multicomponent glasses. The usefulness of this approach is severely limited in some multi-component glasses because of their tendency for phase

separation and crystallization, which lead to inhomogeneous microstructures. GRA

N86-29997# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMICALLY CROSS-LINKED HEAT-SHRINKABLE POLYETHYLENE TUBES
Ion Mihaicea, Silviu Jipa, Sorin Ilie, Constantin Cazac, and Vlaicu Contineanu 10 Apr. 1986 12 p Transl. into ENGLISH from Materiale Plastice (Romania), v. 20, no. 2, Apr. - Jun. 1983 p 113-116
(AD-A166745; FTD-ID(RS)T-0480-85) Avail: NTIS HC A02/MF A01 CSCL 11/9

The memory effect of heat-shrinkable tubes made of low density polyethylene obtained by irradiation with accelerated electrons is presented. The dependence of the cross-linked polyethylene contraction force on time, temperature, degree of cross-linking, etc., is emphasized. Some mechanical, electrical and chemical properties of the irradiated polyethylene are evident. Within the temperature range where the polymers have a thermoelastic benavior, their imprinted deformations lead to macromolecular orientations. These orientations stay after cooling, hence strong inner tension occurs. Through heat, the polymer tends to relax which cancels almost entirely the previous imprinted deformations. This feature is known as plastic materials' memory. The memory phenomenon has been noticed with a large number of polymers such as polyethylene; polypropylene; vinyl-poly-chloride; vinylidenpoly-fluoride; poly-tetra-fluor ethylene; polyurethene; ethylene copolymers with vinyl-acetate, with ethyl-acrylate and with butanyene; neoprene rubber; fluoride rubber; silicone rubber, etc. The experiment shows that the memory effect grows stronger with the increasing number of cross-linking in the polymer. GRA

N86-29998# Department of the Air Force, Washington, D.C.
PHENYLQUINOXALINE RESIN MONOMERS Patent Application
Marilyn R. Unroe, inventor (to Air Force) Filed 16 Jan. 1986 15 p
(AD-D012236; US-Patent-Appl-SN-819334) Avail: NTIS HC A02/MF A01 CSCL 11/9

This invention relates to phenylquinoxaline resin monomers. The acetylene-terminated polyphenylquinoxalines disclosed in a previous invention represent promising new matrix resins for advanced structural materials. These materials propagate and cure by addition reactions to form high molecular weight, thermally stable compositions. The addition process obviates all problems associated with volatile by-product formation that occurs when such materials are prepared by condensation processes. The thermally induced free radical polymerization of aromatic and heterocyclic diacetylenes provides a linear conjugated polyene of 6 to 8 repeating units which results in a cluster-shaped species whose growth is inhibited by the steric hindrance of the monomer or oligomer backbone structure. Although the free radical at the hub of the cluster is reactive, its growth becomes increasing more difficult as the reaction proceeds, reaching a finite limit. Subsequent reaction of dangling acetylene groups of a cluster results in a highly cross-linked polyene network. Such cross-linking has a direct effect on the network topology which manifests itself in mechanical behavior. Phenylquinoxaline monomers containing sterically hindered ethynyl groups are provided by the present invention. These monomers can be crosslinked to provide thermoset resins consisting of a phenylquinoxaline linking unit and an aromatic ether or thioether. GRA

N86-29999# KMS Fusion, Inc., Ann Arbor, Mich.
HOLLOW DROPLET GENERATOR FOR POLYMER SHELL PRODUCTION
R. Crawley 1985 16 p Presented at the 32nd National Vacuum Symposium and Topical Conference, Houston, Tex., 19 Nov. 1985
(Contract DE-AC08-82DP-40152)
(DE86-006482; KMSF-U-1674; CONF-851174-30) Avail: NTIS HC A02/MF A01

Small, spherical, polymer shells are used as fuel containers in inertial fusion experiments. These shells have traditionally been made by spray drying or more recently using droplet generators. It has proven difficult to control product size and wall thickness for thermosetting materials. A dual orifice droplet generator is described for making hollow shell preforms. The inner orifice injects bubbles of a desired gas into the polymer solution droplet stream. The stream is agitated using a piezoelectric diaphragm and produces uniformly size hollow droplets. Shells formed from these hollow preforms have tight distributions of diameter and wall thickness. DOE

N86-30000# Sandia National Labs., Albuquerque, N. Mex.
INTERFACIAL TENSION OF DEMIXED POLYMER SOLUTIONS
J. H. Aubert 1986 4 p Presented at the 191st American Chemical Society National Meeting, New York, N.Y., 13 Apr. 1986
(Contract DE-AC04-76DP-00789)
(DE86-003035; SAND-85-2476C; CONF-860425-14) Avail: NTIS HC A02/MF A01

The interfacial tension of demixed polymer solutions is an important topic because an accurate description of this phenomenon is the first step toward a description of spinodal decomposition in polymer solutions. DeGennes has argued that the interfacial thickness of demixed polymer solutions equals the correlation length in the most concentrated phase. Therefore, a mean field description could not be expected to work. For example, the mean field theory of Roe predicts interfaces much broader than the correlation length and subsequently predicts interfacial tensions smaller than observed by over 100%. In this paper we attempt to make DeGennes' prediction quantitative. This is accomplished by using the Gibb's adsorption isotherm which relates interfacial tension to polymer adsorption and chemical potential. The latter is obtained from an empirical Flory-Huggins fit to equilibrium phase diagrams. The predictions of interfacial tension are quantitative, with an accuracy comparable to that of the empirical fit of the phase diagrams. DOE

N86-30001# Sandia National Labs., Albuquerque, N. Mex.
UV CURED EPOXIDE COATING
K. B. Wischmann 1986 12 p Presented at the 31st National Symposium and Exhibition of the Society for the Advancement of Material and Process Engineering, Las Vegas, Nev., 8 Apr. 1986
(Contract DE-AC04-76DP-00789)
(DE86-003728; SAND-85-1042C; CONF-860438-1) Avail: NTIS HC A02/MF A01

A new uv cured epoxide protective coating has been developed. This coating is based on a cycloaliphatic epoxide that can be cured in seconds with photoinitiators to a clear, durable surface. Modifiers can be added to improve flexibility, toughness, and adhesion. This coating is 100% solids; thus, compared to other solvent based coatings, it has the following advantages: low outgassing, low cure shrinkage, good aging characteristics, rapid processing, low toxicity, abrasion resistance, and excellent electrical and mechanical properties. The coating will bond to virtually any clean substrate. It has been successfully used on several projects and should continue to find wide-spread application. DOE

N86-30002# Oak Ridge National Lab., Tenn.
COMPILATION OF INFORMATION ON COMMERCIALLY AVAILABLE CERAMIC COATINGS FOR HIGH-TEMPERATURE APPLICATIONS
J. Federer, I. and A. J. Moorhead Dec. 1985 41 p
(Contract DE-AC05-84OR-21400)
(DE86-006740; ORNL/TM-9875) Avail: NTIS HC A03/MF A01

Ceramic recuperator materials are exposed to high temperature corrosive/fouling flue gases during service. Recent exposure tests have shown that SiC ceramics are susceptible to corrosion in certain furnace environments. Ceramic coatings might protect SiC ceramics and other recuperator materials from corrosion. This compilation presents commercially available ceramic coatings that could be considered for corrosion protection of heat exchanger materials. The coatings include compositions based on alumina, alumina-magnesia, chromia, hafnia, silica, silicon carbide, titania,

and zirconia. Recommendations for a program to evaluate and compare coatings are also presented. DOE

N86-30003# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
SMALL ANGLE NEUTRON SCATTERING STUDY ON A POLYMER BLEND: CHARACTERIZATION OF THE DEFORMATION BEHAVIOR
J. M. Lefebvre, R. S. Porter, and G. D. Wignall 1986 13 p Presented at the American Society of Plastics Engineers Conference, Boston, Mass., 28 Apr. 1986 Prepared in cooperation with ORNL
(Contract DE-AC05-84OR-21400)
(DE86-006099; CONF-8604120-2) Avail: NTIS HC A02/MF A01

Among the various techniques developed to characterize the structure of polymer blends, Small Angle Neutron Scattering (SANS) has received considerable attention over the past few years. By using SANS it is possible to determine the conformation of the polymer chain as well as the interaction parameter between the components of the blend. DOE

N86-30004# Los Alamos National Lab., N. Mex.
THERMOCHEMICAL MODELING OF CERAMIC SYSTEMS FORMED BY COMBUSTION
R. G. Behrens and H. T. Brush 1985 25 p Presented at the DARPA/ARMY Symposium, Daytona Beach, Fla., 21 Oct. 1985 Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge.
(Contract W-7405-eng-36)
(DE86-007370; LA-UR-86-751; CONF-8510280-8) Avail: NTIS HC A02/MF A01

Preliminary work showed that an appropriate stoichiometric mixture of yttrium, silicon dioxide, and graphite will react exothermically. However, the product which was formed was not the desired Y2O3 + SiC mixture, but rather a complex eutectic-like material. Preliminary attempts to ignite an exothermic reaction with an appropriate stoichiometric mixture of zirconium, silicon dioxide, and graphite (which was predicted to react and to form a ZrO2 + SiC mixture) were not successful. The approach used to further study the high-temperature synthesis chemistry of these two complex chemical systems involved using equilibrium thermochemical modeling techniques. Parametric studies were performed to evaluate the effect of temperature and pressure on the gas and solid equilibrium phase relationships. While system temperature and pressure were varied in a systematic manner, stoichiometry of the reacting materials was held constant according to the equations 4Y + 3SiO2 + 3C = 2Y2O3 + 3SiC and Zr + SiO2 + C = ZrO2 + SiC. DOE

N86-30005# Sandia National Labs., Albuquerque, N. Mex.
ULTRA-LOW DENSITY MICROCELLULAR FOAMS
P. B. Rand 1986 12 p Presented at the 5th Annual Target Fabrication Specialists Meeting, Las Vegas, Nev., 24 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-007701; SAND-86-0407C; CONF-860330-1) Avail: NTIS HC A02/MF A01

Ultra-low density (<6.0 mg/cc) microcellular foams (cell size less than 20 microns) have been developed to support the NARYA pulsed-power-driven X-ray laser program. Other pulsed power targets using these foams are anticipated. Because of the extreme fragility of these foams emphasis was placed on molding to shape to avoid machining. The foams are made by a thermally induced phase separation process from solutions of water soluble polymers. In practice the solutions are rapidly frozen to induce the phase separation, and they are then freeze dried to remove the solvent without destroying the foam's structure. A number of water soluble polymers have proven capable of meeting the density and cell size requirements. However, polyacrylic acid was used in most of our work because of its low shrinkage during molding and its purity. These foams have been molded into rods (1, 2, and 3 mm dia.), half rods, half annuli, and most recently full annuli with 3.0 mm outside diameter and 2.0 mm inside diameter. The molding techniques have varied with the various shapes. The rods were molded by freezing the solution in thin walled silicone rubber molds, extracting the frozen preform from the mold, and then freeze drying. Metal molds were used to make all other shapes. Rapid surface melting, followed by rapid refreezing, was used to remove the more complex shapes from their molds. In the case of the foam annuli, a pin with a very small taper was used to form the inner diameter. The foam rods have been successfully used in gas-puff implosion experiments on the PROTO-II accelerator. DOE

N86-30006# Florida Univ., Gainesville. Dept. of Chemistry.
SYNTHESIS OF MODEL POLYMERS AND RELATED STRUCTURES IN SUPPORT OF VINYL MONOMER GRAFTING STUDIES Progress Report
T. E. Hogen-Esch and G. B. Butler 15 Jan. 1986 35 p
(Contract DE-FG05-84ER-45104)
(DE86-008204; DOE/ER-45104/2) Avail: NTIS HC A03/MF A01

The objectives of the proposed research program are to study graft copolymerization of vinyl monomers onto cellulose or cellulose derivatives. Grafting will be carried out by redox initiation such as Ce(4+), by thermal decomposition (cellulose xanthates), or by nucleophilic displacement of cellulose derivatives by living polymers. The structure of the resulting water-soluble graft copolymer will be determined as well as the grafting efficiency of the initiation systems. Cellulose derivatives containing side chains capable of micellization will also be synthesized. In support of these objectives, water-soluble, block-, star- and cyclic polymers will be synthesized in order to aid in establishing property-structure relationships. Characterization of the polymers will be carried out by IR and by proton or carbon-13 NMR as well as size exclusion chromatography, viscometry, osmometry and other physico chemical techniques. Rheological studies designed to clarify structure-rheology relationships are also planned. DOE

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N86-30007# Federal Aviation Administration, Washington, D.C. Program Engineering and Maintenance Service.
PROCEEDINGS OF FUEL SAFETY WORKSHOP
31 Dec. 1985 382 p Workshop held in Alexandria, Va., 29 Oct. - 1 Nov. 1985 Prepared in cooperation with Analysis Group, Inc., Washington, D.C.
(DOT/FAA/PM-86/13) Avail: NTIS HC A17/MF A01 CSCL 21D

The workshop served a four-fold purpose: (1) to discuss the results of the Federal Aviation Administration/NASA Controlled Impact Demonstration (CID) conducted December 1984 at Edwards Air Force Base, California; (2) to explore potential approaches to preventing post-crash aircraft fuel fires, including possible combinations of various approaches; (3) to re-evaluate past approaches in terms of current technology; and (4) to propose a course of action for future industry/government research, especially any future FAA research and development program. These proceedings contain the formal conference presentations followed by the recommendations of the attendees as agreed upon in the three informal working breakout sessions. For individual titles, see N86-30008 through N86-30022.

N86-30008# Federal Aviation Administration, Washington, D.C.
ANTIMISTING FUEL TECHNOLOGY FOR TRANSPORT CATEGORY AIRCRAFT
E. P. Klueg *In its* Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 11-60 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

The antimisting kerosene (AMK) program is described. Details of the production and testing of AMK are given. Rheological studies

on properties of antimisting, filtration, flammability, and viscoelasticity; heat transfer and frictional characteristics; and degradation levels are described. AMK flammability tests were performed in both the laboratory and in air crashes. Production details presented include in-line blending limitations and compatibility and degradation considerations. The organizational structure of the AMK development effort is described, and economic aspects of converting to AMK are discussed. J.P.B.

N86-30009# Federal Aviation Administration, Washington, D.C.
AMK FULL-SCALE TRANSPORT AIRCRAFT VALIDATION PHASE SUMMARY
Bruce C. Fenton *In its* Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 61-114 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

Fuel system modifications for CV-880 and B-720 aircraft were designed, built, and flight/crash tested in a controlled impact demonstration (CID),in order to assess the feasibility of antimisting kerosene (AMK) in fire retardation. Central to the fuel system modification was the degrader design. The inline blending of AMK at fueling point demonstrated consistently high fuel quality. The degrader demonstrated successful flight operation, and engine performance under degraded AMK was comparable to performance with jet A under nominal flight conditions. It is concluded that transport aircraft can operate on AMK with minor modifications, although there are accident scenarios where AMK may not prevent a fuel spill fireball attachment to the wing/fuselage. J.P.B.

N86-30010# Federal Aviation Administration, Washington, D.C.
POST CONTROLLED IMPACT DEMONSTRATION (CID) ANALYSIS
William T. Westfield *In its* Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 115-135 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

The unplanned deviations in a Controlled Impact Demonstration (CID) to test an antimisting kerosene (AMK) are reported. Post-impact tests were conducted to assess the performance of the fire-retardant fuel; some of these tests were modified because of the deviations from the planned impact. The history of the planning of the CID is given. Experiments to explain the (often unexpected) behavior of the fuel on impact were conducted. It is concluded that the CID was not typical of accident impacts and that the antimisting fuel was exposed to circumstances which it was not designed to withstand. Even so, the antimisting fuel presented a less hostile environment through its slower vaporization and heat release. J.P.B.

N86-30011# Federal Aviation Administration, Washington, D.C.
FAA FUEL CONTAINMENT R AND D
Lawrence M. Neri *In its* Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 137-148 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

Fuel containment research by the Federal Aviation Administration (FAA) is summarized. The objective is to make post-crash fires less fatal and injurious. Three types of aircraft (transport airplanes, rotorcraft, and general aviation airplanes) are addressed independently. Data presented include: (1) compilation of accident data generated by airplane manufacturers; (2) accident percentage versus major failure modes; (3) accident percentage versus fire and fatalities; (4) impact events which possess the highest fuel spill potential; (5) generic technical approach addressing fuel containment; and (6) sequence of events leading to design criteria to satisfy program objectives. J.P.B.

N86-30012# Royal Aircraft Establishment, Farnborough (England). Materials and Structures Dept.
UK WORK ON SAFETY FUELS
S. P. Wilford *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 163-179 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

Work on safety fuels in the United Kingdom is described with respect to antimisting fuel development, fuel systems design, degradation, blending, and engine combustion. Current research focuses on cavitation studies, where preliminary results indicate that use of FM9 antimisting kerosene (AMK) may lead to increased cavitation damage; and quality control, where a Capillary Trajectory Rig (CTR) has advanced quality testing to the point where a margin of fire safety may be determined. Finally, investigation of the unexpected results of the Controlled Impact Demonstration (CID) is briefly reported. J.P.B.

N86-30013# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HEAT TRANSFER, FRICTION, AND RHEOLOGICAL CHARACTERISTICS OF ANTIMISTING KEROSENE
E. Matthys and V. Sarohia *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 181-183 (For primary document see N86-30007 21-28)
(Contracts NAS7-918; DTFA03-80-00215)
Avail: NTIS HC A17/MF A01 CSCL 21D

Experiments were performed to determine the skin friction and heat transfer behavior of antimisting kerosene (AMK) in pipe flows. The additive used was FM-9. Based on the results of the experiments, which identify high viscosity and viscoelasticity for AMK, it is recommended that AMK be degraded. Sufficient degradation produces behavior similar to that of jet A. J.P.B.

N86-30014# Army Fuels and Lubricants Research Lab., San Antonio, Tex.
US ARMY FIRE RESISTANT FUEL (FRF) PROGRAM PRESENTATION TO FAA AVIATION FUEL SAFETY MEETING
Forrest W. Schaekel *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 185-201 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

In its search for a diesel fuel that will self-extinguish in case of ignition, the U.S. Army has most recently investigated the inclusion of surfactant-stabilized emulsified water in diesel fuel. Such aqueous microemulsions yield diminished mist flammability while either eliminating pool burning or providing rapid self-extinguishment of pool fires. The Fire-Resistant Fuel (FRF) has such pool-fire resistance, but logistical constraints and low-temperature instability preclude for the time being Army-wide adaptation of this fuel. The recommendation of a Short-Term Advisory Services team led to ballistic tests with cooled fuel and antimisting agents, in which 90 mm shaped charges have been used against armored personnel carrier fuel tanks. J.P.B.

N86-30015# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONTINUOUS INLINE BLENDING OF ANTIMISTING KEROSENE
P. Parikh, A. Yavrouian, and V. Sarohia *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 203-217 (For primary document see N86-30007 21-28)
(Contracts NAS7-917; DTFA03-80-A-00215)
Avail: NTIS HC A17/MF A01 CSCL 21D

A continuous inline blender was developed to blend polymer slurries with a stream of jet A fuel. The viscosity of the slurries ranged widely. The key element of the blender was a static mixer placed immediately downstream of the slurry injection point. A positive displacement gear pump for jet A was employed, and a progressive cavity rotary screw pump was used for slurry pumping. Turbine flow meters were employed for jet A metering while the slurry flow rate was calibrated against the pressure drop in the injection tube. While using one of the FM-9 variant slurries, a provision was made for a time delay between the addition of slurry and the addition of amine sequentially into the jet A stream. J.P.B.

N86-30016# Conoco, Inc., Ponca City, Okla.
OLEFIN POLYMERS AS JET FUEL ANTIMIST ADDITIVES
Steven L. Baxter and John M. Iwasyk (Du Pont de Nemours

(E. I.) and Co., Wilmington, Del.) *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 221-240 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

Ultra-high molecular weight, oil-soluble polymers (designated AM-2) have been developed which may have potential as antimist additives. Tests show that these polymers significantly reduce the concentration of fines in fuel spray and increase mean particle diameter. Impact of the additives on other fuel properties is briefly discussed. J.P.B.

N86-30017# ICI Americas, Inc., Wilmington, Del.
AMK: STILL VIABLE?
Charles G. Rivers, Jr. *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 241-249 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

The status of antimisting kerosene (AMK) as a fire-retardant fuel is discussed. Research to date indicates the likelihood that antimisting is effective; future research must be aimed at identifying the envelope of effectiveness. Existing technology appears adequate to provide for the onboard blending requirement for using AMK. Few problems in the area of aircraft operability using AMK have been encountered to date; however, a number of potential problems related to gelling remain. Extended engine testing may effectively address remaining concerns. J.P.B.

N86-30018# McDonnell-Douglas Corp., Long Beach, Calif.
SAFETY FUELS-SPECIFICATIONS AND PROGRESS
A. T. Peacock *In* FAA Proceedings Fuel Safety Workshop 31 Dec. 1985 p 255-260 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

This paper discusses fuel standardization and quality control and the mechanisms already in place to attain them. It reflects 20 years of development of safety fuels and considers where the Federal Aviation Administration (FAA) should go from here. The need for a standard technical description of aviation turbine fuels that are developed to enhance fuel safety is discussed. Fuel property descriptions, test methods, and standardization procedures are also discussed, along with approvals for additives and fuel quality control. The role of the American Society for Testing and Materials (ASTM) in standardization is outlined, and a short history of safety fuels is given. It is suggested that fuel modification should not be abandoned as a method of improving safety. Author

N86-30019# Boeing Co., Seattle, Wash.
CURRENT DESIGN PROCEDURES FOR MINIMIZING POST CRASH FIRE HAZARDS **c03**
H. Skavdahl *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 261-276 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

In designing jet aircraft fuel systems, experience has resulted in current attention to the following considerations for fire safety: (1) elimination of ignition sources; (2) where (1) is not possible, minimizing oxygen supply, ventilating the fuel sufficiently to prevent combustible mixtures, or eliminating the fuel source with valves or drains; (3) shrouding of fuel lines in pressurized compartments; (4) impact-resistant location of fuel tanks; (5) safety features for pressure fueling; (6) strut breakaway design; and (7) fire walls, air cooling, and careful location of fuel system components to further minimize fire hazards. Airplane fuel systems are discussed in general, and criteria which must be satisfied in the design of a new component or subsystem are described. J.P.B.

N86-30020# Aviation Fuel Safety Co., Chelmsford, Mass.
AMINE-CO2 ADDUCTS AS AVIATION FUEL GELLING AGENTS **c03**
William W. Bannister *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 279-298 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

On addition of small amounts of cyclododecylamine (CDDN) to jet fuels, with subsequent addition of CO2, a zwitterionic carbamate forms to set up a gelling matrix within the fuel. This system is proposed for application in controlled crash landings in which the crew would have one or two second to undertake fire-prevention measures. There is also a possibility for use in very low non-gelling concentrations which may still provide antimisting kerosene (AMK) characteristics, in which case there would be no weight penalties and no reaction time would be required. Use with other additives may provide synergistic effects. Cost estimates, payload requirements, heat of combustion and NOx emission data are included. Author

N86-30021# General Technology Applications, Inc., Reston, Va.
GTA/BASF ANTIMISTING FUEL RESEARCH
Jerry C. Trippe *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 301-311 (For primary document see N86-30007 21-28)
Avail: NTIS HC A17/MF A01 CSCL 21D

The research resulting in a process for dissolving polyisobutylene (PIB) in antimisting fuel is described. Reasons for continued private industry research into antimisting fuel are outlined. The background of investigations of the relationship between high molecular weight polymer additives, droplet size, and mist-induced fires is reported. The promise of PIB in antimisting fuels is summarized on the basis of theses characteristics: (1) satisfactory effectiveness at very low concentrations; (2) satisfactory effectiveness under high shear forces; (3) compatibility with current fuel specifications and unmodified fuel systems; (4) low cost under current high volume production; (5) ease of handling and application; and (6) elimination of catastrophic fuel explosions. J.P.B.

N86-30022# Akron Univ., Ohio.
JET FUEL VISCOSITY AT LOW TEMPERATURES WITH NOTES ON n-ALKALINE CRYSTALS Final Report **c03**
Dale Schruben *In* FAA Proceedings of Fuel Safety Workshop 31 Dec. 1985 p 317-356 (For primary document see N86-30007 21-28)
(Grant NAG3-488)
(NASA-CR-174911; NAS 1.26:174911) Avail: NTIS HC A17/MF A01 CSCL 21D

Apparatus and procedures were developed to collect jet fuel viscosity versus temperature data for temperatures down to about -60 deg C in a manner compatible with prior jet fuel data bases generated with the Brookfield viscometer. Viscosity data showed good reproducibility even at temperatures a few degrees into the two-phase region. The viscosity-temperature relationship could be correlated by two linear segments when plotted as a standard log-log type representation. The breakpoint between the high and low temperature line segments is the filter flow temperature, a fuel characteristic approximated by the freezing point. A generalized correlation appears sufficiently accurate for many design or performance calculations. In the low temperature two-phase region, wax precipitation is significant. Qualitative literature was quantitatively analyzed along with data in this study to plot crystal size versus composition for the fuel model C sub 20-C sub 24 n-alkane system in solvent. This suggested that wax mixtures tend towards smaller crystal sizes than pure wax species. Complex mixtures in jet fuels lead to two-phase states, at least in some instances, that have small enough crystals to be treated as a continuum.
Author

N86-30023*# United Technologies Research Center, East Hartford, Conn.
ROLE OF FUEL CHEMICAL PROPERTIES ON COMBUSTOR RADIATIVE HEAT LOAD
T. J. Rosfjord 19 Apr. 1984 36 p
(Contract NAS3-23167)
(NASA-CR-177096; NAS 1.26:177096) Avail: NTIS HC A03/MF A01 CSCL 21I

In an attempt to rigorously study the fuel chemical property influence on combustor radiative heat load, United Technologies Research Center (UTRC) has conducted an experimental program using 25 test fuels. The burner was a 12.7-cm dia cylindrical device fueled by a single pressure-atomizing injector. Fuel

physical properties were de-emphasized by selecting injectors which produced high-atomized, and hence rapidly-vaporizing sprays. The fuels were specified to cover the following wide ranges of chemical properties; hydrogen, 9.1 to 15- (wt) pct; total aromatics, 0 to 100 (vol) pct; and naphthalene, 0 to 30 (vol) pct. They included standard fuels, specialty products and fuel blends. Fuel naphthalene content exhibited the strongest influence on radiation of the chemical properties investigated. Smoke point was a good global indicator of radiation severity. Author

N86-30024# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ANTIMISTING KEROSENE: EVALUATION OF IMPROVED FM-9 ADDITIVE Final Report, Aug. 1983 - Nov. 1984

A. Yavrouian, P. Parikh, and V. Sarohia Jun. 1986 51 p
(Contract DTFA3-80-A-00215)
(DOT/FAA/CT-85-4; JPL-D-2581) Avail: NTIS HC A04/MF A01

During the past few years, studies by the Federal Aviation Administration (FAA) and other government agencies have shown that the hazards from aircraft crash fires might be significantly decreased if an antimisting kerosene (AMK) fuel could be utilized. The addition of polymeric additive at low concentrations to jet fuels is known to suppress mist formation and ignition of the fuels under circumstances often encountered in survivable aircraft crash landings. An antimisting additive, FM-9 (Trademark) has been developed by Imperial Chemical Industries (ICI) and is available under the trade name AVGARD. This material when dissolved in jet fuels imparts a strong time-dependent threshold type shear-thickening behavior. In case of fuel spillage from a ruptured fuel tank during an aircraft crash, the fuel misting is prevented. Simulated aircraft crash landing fuel spillage tests have indicated that fuel misting can be sufficiently suppressed, and the ignition and the subsequent fireball formation can be greatly reduced or eliminated. Optimization of FM-9 dissolution rate to attain acceptable mist suppression and degradation properties within 15 to 20 minutes of inline blending was carried out by ICI. This report discusses the evaluation of FM-9 variant which has better dissolution rate and consequently better degradability and compatibility with engine filters and fuel control system and was identified as a candidate additive to be used in a Control Impact Demonstration (CID) test. Author

N86-30025# Ballistic Research Labs., Aberdeen Proving Ground, Md.

THEORETICAL AND EXPERIMENTAL INVESTIGATION OF FLAMESPREADING PROCESSES IN COMBUSTIBLE-CASED, STICK PROPELLANT CHARGES

Thomas C. Minor and Albert W. Horst Feb. 1986 40 p
(AD-A166461; AD-E301935; BRL-TR-2710) Avail: NTIS HC A03/MF A01 CSCL 19/6

Attention has shifted over recent years in the United States to the use of stick propellant in high-performance artillery charges. The substitution of the natural flow channels offered by a bundle of stick propellant over the tortuous path encountered in a bed of granular propellant all but eliminates the problem of pressure waves so often associated with high-pressure gun malfunctions. Further, performance advantages may be realizable because of the higher natural loading density of stick propellant as well as unique hydrodynamic features associated with its geometry. However, recent testing has revealed that the postulated flow of igniter gases and flamespreading from the basepad forward through the bundle of sticks in a simple, one-dimensional manner may be significantly complicated by the presence of a combustible case, the initial permeability, mechanical strength, and ignition and combustion characteristics of which may play major roles themselves in characterizing the aforementioned sequence of events. The US Army has just completed development of a new top-zone propelling charge designated M203E2 and type classified M203A1 to replace the M203 Charge for the 155-mm, M198 Towed Howitzer. A number of these charges were modified to permit direct viewing of the interior of the charge and fired in the Ballistic Research Laboratory 155-mm Howitzer Simulator. Companion calculations were performed using the TDNOVA two-dimensional, two-phase interior ballistic code. GRA

N86-30026# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

COMPARISON OF EXTRACTION TECHNIQUES AND SOLVENTS FOR EXPLOSIVE RESIDUES IN SOIL

Thomas F. Jenkins and Daniel C. Leggett Nov. 1985 37 p
(AD-A166474; CRREL-SR-85-22; AMXTH-TE-TR-85041) Avail: NTIS HC A03/MF A01 CSCL 07/1

Extraction of TNT, Trinitrobenzene, RDX and HMX from two soils was studied in terms of process kinetics and recovery. Two solvents, acetonitrile and methanol, and four extraction techniques, Soxhlet, ultrasonic bath, mechanical shaker and homogenizer-sonicator were compared. The results were complex in that some interactions among analyte, method and solvent were found. Acetonitrile was found to be clearly superior to methanol for RDX and HMX. Soxhlet and ultrasonic bath generally recovered more than homogenizer or shaker, although a complicating factor is that all techniques were not necessarily at equilibrium. In terms of sample throughput, the ultrasonic bath and shaker are preferred over Soxhlet and homogenizer-sonicator. The ultrasonic bath generally approached equilibrium more rapidly than the shaker so it appears to be the best overall choice. Another complicating factor is that times to reach equilibrium were different for the two soils and for the different analytes. This points to the need for more kinetic studies on other soils and sediments. plosives; HMX; Pollution; RDX; Soil pollution; Soils; TNT; TNB. GRA

N86-30027# Army Armament Research and Development Command, Dover, N. J. Armament Engineering Directorate.

SCANNING ELECTRON MICROSCOPE STUDY OF NITROGUANIDINE, M31A1 AND m30 PROPELLANTS

Scott Morrow Apr. 1986 41 p
(AD-A166669; AD-E700023; ARAED-TR-86011) Avail: NTIS HC A03/MF A01 CSCL 19/1

Canadian nitroguanidine (NQ) used in triple base propellant ceased to be manufactured in 1978. In order to provide a replacement for this critical material, manufacture was initiated at the Sunflower Army Ammunition Plant (SFAAP). A critical part of the process is control of particle size. A difficult problem in this regard is the on-stream measurement of the particle size. Nor is it a trivial matter to measure the particle size of the end product. Comprehensive studies have been made of the best means for making both types of particle size measurements. The Fisher Sub Sieve Sizer (FSSS) is the current specification method used to measure the dry product. Many other methods have been investigated, too. Scanning electron photomicrographs were made of a reference sample of nitroguanidine (NQ). Similar photos of nitroguanidine made at the Sunflower Army Ammunition Plant (SFAAP) and at the U.S. Army Armament Research and Development Center (ARDC) were compared to the Canadian reference material. From these photomicrographs the range of crystal sizes in the different samples was estimated. These NQ samples were incorporated into M31A1 and M30 propellants. Scanninng electron microscope (SEM) photomicrographs of the resultant propellants revealed the long NQ needles break up during processing and that particle size differences in the original NQ are also seen in the same order in finished products. GRA

N86-30028# Lawrence Livermore National Lab., Calif.

EIGHTH SYMPOSIUM (INTERNATIONAL) ON DETONATION, VOLUME 3

1985 240 p Symposium held at Albuquerque, N. Mex., 15 Jul. 1985
(Contract W-7405-eng-48)
(DE86-006785; CONF-850706-Vol-3) Avail: NTIS HC A11/MF A01

Volume three contains twenty-eight papers on chemical explosives and detonations. All papers have been processed for inclusion in the Energy Data Base. DOE

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N86-30029# Federal Aviation Administration, Washington, D.C.
RESILLIENT MODULUS OF FREEZ-THAW AFFECTED GRANULAR SOILS FOR PAVEMENT DESIGN AND EVALUATION. PART 1: LABORATORY TESTS ON SOILS FROM WINCHENDON, MASSACHUSETTS, TEST SECTIONS
D. Cole, D. Bentley, G. Durell, and T. Johnson Jul. 1986 78 p Sponsored in part by Army
(Contract FHWA8-3-0187)
(FAA/PM-84/16.1; CRREL-86-4) Avail: NTIS HC A05/MF A01

This is the first of a series of four reports about laboratory and field testing of various granular road and airfield subgrades. This report details the acquisition, testing and analysis of six soils from a test site in Winchendon, Massachusetts. Repeated load triaxial tests were done on frozen and thawed soils to characterize the variations in the their resilient properties throughout the seasons. Linear regression yielded empirical equations relating the resilient modulus to applied stress, unfrozen water content (for frozen soils), moisture tension (for thawed soils) and density. Equipment and test procedures (given in detail) were developed that allowed simulation in the laboratory of the gradual recovery of stiffness that occurs in the field after thawing. The resilient moduli were strongly dependent on soil state, dropping at least two orders of magnitude upon thawing. For all soils the moduli increased with increasing confining stress, generally decreased with increasing principal stress ratio, and increased with increasing moisture tension levels. The resilient moduli increased by a factor of approximately two as the materials recovered from the effects of a freeze-thaw cycle. The recovery process is well modeled as a function of soil moisture tension level. The stress sensitivity did not appear to be a function of the soil moisture tension level. The report also includes tabulations of all the repeated load triaxial test data. Author

N86-30030# Kernforschungsanlage, Juelich (West Germany).
CRITERIA FOR THE CHOICE OF WORK PIECES FOR CONVENTIONAL OR NUMERICAL-CONTROL (NC) MANUFACTURING (TURNING, DRILLING, AND CUTTING) [KRITERIEN ZUR AUSWAHL VON WERKSTUECKEN FUER KONVENTIONELLE ODER NC-FERTIGUNG (DREH-, BOHR- UND FRAESBEARBEITUNG)]
C. Doose Nov. 1985 50 p In GERMAN
(JUEL-SPEZ-338; ISSN-0343-7639; ESA-86-97420) Avail: NTIS HC A03/MF A01

Methods to prepare and check the use of conventional and numerical control (NC) machines in research workshops where single and prototype manufacturing prevail are discussed. The methods permit determination of which work pieces are suited for conventional and which for NC-machining. The methods of qualified work piece visual assessment and of the comparison of fabrication costs provide evaluation criteria. Starting from manufacturing-relevant geometrical and technological characteristics, the work pieces to be produced can be objectively classed with a single machine type. The results over a one-year period can give a reliable basis for long term investment decisions. If the requirements are fulfilled, conventional machines should be replaced by NC-machines, although the number of NC-machines is very limited compared to conventional machines. ESA

N86-30031# Office of Technology Assessment, Washington, D.C.
ANTI-SATELLITE WEAPONS, COUNTERMEASURES, AND ARMS CONTROL
Sep. 1985 16 p
(PB86-182953; OTA-ISC-281; LC-85-600587) Avail: NTIS HC A02/MF A01 CSCL 15C

Anti-satellite weapons, countermeasures, and arms control; MILSATs, ASATs, and national security; ASAT capabilities and countermeasures; ASAT arms control: history; ASAT arms control: options; and a comparative evaluation of ASAT policy options are discussed. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N86-30032 Forschungsinstitut fuer Hochfrequenzphysik, Werthoven (West Germany).
DATA TRANSMISSION BY RADAR
H.-J. Bueckmann Aug. 1985 36 p In GERMAN; ENGLISH summary Sponsored by Bundesministeriums der Verteidigung
(Rept-8-85; Lfd-239; ESA-86-97416) Copyright. Avail: Issuing Activity

The use of the radar for jamming-resistant data transmission was investigated. The possibilities and limits of data transmission via mechanically rotating radars are presented. The low time and spatial duty cycle of the radar pulses and the antenna main beam, respectively, result in a low average data rate. Thus only short messages of the order of 100 bit during each antenna rotation cycle can be transmitted with high resistance against jamming. A lower immunity from disturbance must be tolerated in order to increase the data rate. Several methods are described, consisting of the modification of signal parameters and modulation, and the use of the antenna sidelobes for transmission. A concept of burst transmission with preamble detection in order to circumvent the high detection loss due to fluctuating sidelobes is given. ESA

N86-30033 Forschungsinstitut fuer Hochfrequenzphysik, Werthoven (West Germany).
A COMPARISON OF METHODS FOR ADAPTIVE JAMMING SUPPRESSION
J. Worms Aug. 1985 80 p In GERMAN; ENGLISH summary
(Contract BMvG-T/RF31/71435/71340)
(Rept-9-85; Lfd-240; ESA-86-97417) Copyright. Avail: Issuing Activity

Methods for the optimal suppression of jamming in partially adaptive antenna arrays were developed. Recursive algorithms to solve the Wiener filter equation were considered. The iteration methods sample matrix gradient, single step method, and successive-over-relaxation were generalized to stochastic approximation methods. The direct methods of recursive covariance matrix decomposition as well as spatial lattice filters were derived. The methods are illustrated by simulations and by a comparison of the number of point operations of the variance, and of the convergence rate. ESA

N86-30034 Forschungsinstitut fuer Hochfrequenzphysik, Werthoven (West Germany).
RADAR DETECTION RANGES, TAKING INTO ACCOUNT WAVE PROPAGATION PHENOMENA
H. Kuschel Oct. 1985 39 p In GERMAN; ENGLISH summary
(Contract BMvG-T/RF31/E0020/E1317)
(Rept-13-85; Lfd-244; ESA-86-97419) Copyright. Avail: Issuing Activity

Radar detection ranges were studied under real conditions, taking into account atmospheric refraction and diffraction effects on the detection of low flying objects. The topographic information was derived from a digital terrain data base. This allows the calculation of the attenuation of an electromagnetic field due to the actual terrain profile. The use of a digital computer provides access to the terrain data base as well as the calculation of frequency and terrain-specific mean values of the detection range, based on a statistically relevant number of simulations. Target direction errors due to diffraction at a vertical edge are discussed. ESA

N86-30035*# Hawaii Univ., Manoa. Dept. of Electrical Engineering.
CODING FOR RELIABLE SATELLITE COMMUNICATIONS Final Report, 1 Jul. 1984 - 30 Jun. 1986
N. T. Gaarder and Shu Lin 1986 21 p
(Grant NAG5-407)
(NASA-CR-177262; NAS 1.26:177262) Avail: NTIS HC A02/MF A01 CSCL 17B

This research project was set up to study various kinds of coding techniques for error control in satellite and space communications for NASA Goddard Space Flight Center. During the project period, researchers investigated the following areas: (1) decoding of Reed-Solomon codes in terms of dual basis; (2) concatenated and cascaded error control coding schemes for satellite and space communications; (3) use of hybrid coding schemes (error correction and detection incorporated with retransmission) to improve system reliability and throughput in satellite communications; (4) good codes for simultaneous error correction and error detection, and (5) error control techniques for ring and star networks. Author

N86-30036# Centre National d'Etudes Spatiales, Toulouse (France).
VARAN-S: AN AIRBORNE SYNTHETIC APERTURE RADAR FOR RESEARCH IN MICROWAVE REMOTE SENSING
D. Vaillant 3 May 1985 10 p Presented at EARSeL Symposium, Strasbourg, France, 31 Mar. 3 Apr. 1985
(CNES-CT/DRT/TIT/RL-93-T; ESA-86-97185) Avail: NTIS HC A02/MF A01

An X-Band side-looking airborne radar, VARAN-S, was tested in real aperture mode in the Marginal Ice Zone experiment. The VARAN-S is planned to work in SAR mode. The digital raw data, recorded on-board over a swath width $>$ 10 km, is processed with 3 m resolution without multilook, or 9 m resolution using 9 looks. Two polarizations (H and V) are available. The VARAN-S is designed to simulate satellite-borne radar images to make microwave remote sensor users ready for satellite data analyses and help the development of satellite-borne SAR. ESA

N86-30037*# Illinois Univ., Urbana. Electromagnetic Communication Lab.
MMIC DEVICES FOR ACTIVE PHASED ARRAY ANTENNAS Final Report
R. Mittra 31 Jul. 1986 61 p
(Contract NCC3-8)
(NASA-CR-176990; NAS 1.26:176990) Avail: NTIS HC A04/MF A01 CSCL 20N

The use of finlines for microwave monolithic integrated circuit application in the 20 to 40 GHz frequency range. Other wave guiding structures, are also examined from a comparative point of view and some sonclusions are drawn on the basis of the results. For individual titles, see N86-30038 through N86-30038.

N86-30038*# Illinois Univ., Urbana.
ASYMMETRICAL COUPLED COPLANAR-TYPE TRANSMISSION LINES WITH ANISOTROPIC SUBSTRATES
Toshihide Kitazawa, Yoshio Hayashi, and Raj Mittra *In its* MMIC Devices for Active Phased Array Antennas 31 Jul. 1986 32 p
(For primary document see N86-30037 21-32)
Avail: NTIS HC A04/MF A01 CSCL 20N

Various types of transmission lines with anisotropic substances were investigated for use in microwave and millimeter wave integrated circuits. These include single and coupled striplines, slot lines, and coplanar-type transmission lines. The coplanar-type transmission lines (CTLs) are promising because of their easy adaptation to shunt element connections. The application of coupled coplanar-type transmission lines (C-CTLs) were studied based on the quasistatic and hybrid mode formulations and accurate numerical values are available for the cases with isotropic and/or anisotropic substrates. However, most of them assume structural symmetry. The theoretical approach for the asymmetrical version is available only for the propagation constant of the case with a single isotropic substrate. The analytical method for the general structure of asymmetrical C-CTLs with an anisotropic substrate. This method includes both the hybrid mode and the quasistatic formulations and is useful for accurately computing the characteristics impedances as well as propagation constants of various types of assymetrical C-CTLs. GRA

N86-30039*# Illinois Univ., Urbana-Champaign. Electromagnetics Lab.
A SIMPLE CIRCULAR-POLARIZED ANTENNA: CIRCULAR WAVEGUIDE HORN COATED WITH LOSSY MAGNETIC MATERIAL
C. S. Lee, S. W. Lee, and D. W. Justice Aug. 1986 32 p
(Grant NAG3-475)
(NASA-CR-177092; NAS 1.26:177092; UILU-ENG-86-2554; ELSR-86-8) Avail: NTIS HC A03/MF A01 CSCL 20N

A circular waveguide horn coated with a lossy material in its interior wall can be used as an alternative to a corrugated waveguide for radiating a circularly polarized (CP) field. To achieve good CP radiation, the diameter of the structure must be larger than the free-space wavelength, and the coating material must be sufficiently lossy and magnetic. This device is cheaper and lighter in weight than the corrugated one. Author

N86-30040# University of South Florida, Tampa. Dept. of Electrical Engineering.
ANALYTICAL METHODS FOR CHARACTERIZATION OF NONLINEAR DEVICES AND NETWORKS, VOLUME 1 Final Report, Apr. 1983 - Apr. 1984
V. K. Jain, S. J. Garrett, and A. R. Gondeck Dec. 1985 54 p
(Contract F30602-82-C-0135)
(AD-A165837; RADC-TR-85-243-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 17/2

Multichannel communication systems are often mildly nonlinear and can be characterized by a truncated Volterra series. The purpose of this report is to present, in a practical way, techniques for effective representation of nonlinear circuits/systems by Volterra NLFTs. The nonlinear current method is applied to various communication type problems. These include systems of nonlinear differential equations, nonlinear devices, and nonlinear circuits. GRA

N86-30041# University of South Florida, Tampa. Dept. of Electrical Engineering.
STABLE COMPENSATION OF NONLINEAR COMMUNICATIONS SYSTEMS (USING VOLTERRA SYSTEMS CHARACTERIZATION), VOLUME 2 Final Report, Jan. 1984 - Apr. 1985
V. K. Jain and T. E. McClellan Dec. 1985 98 p
(Contract F30602-82-C-0135)
(AD-A165838; RADC-TR-85-243-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 17/2

Using a mean-square IM criterion, a new approach for the reduction of intermodulation distortion is developed here. Advantages realized are: (1) reduction of IM distortion by 15 to 50 dB, (2) guaranteed stability of the compensator, (3)a minimum prespecified damping ration of the blocks of the nonlinear compensator. A design program based on the approach is also presented. GRA

N86-30042# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL STUDY OF CHEMICAL ALLEVIATION FOR IMPROVING REENTRY COMMUNICATION
Zonghou Chu, Boyi Wang, and Lie Lin 5 Feb. 1986 23 p Transl. into ENGLISH from Lixue Xuebao (China), v. 16, no. 5, Jul. 1984 p 408-416
(AD-A165862; FTD-ID(RS)T-1049-85) Avail: NTIS HC A02/MF A01 CSCL 17/2

Chemical alleviation for improvement of reentry communication by solid ablation and liquid injection has been a practical technique. The mechanism of chemical alleviation and the method of experimental studies of simulation in an arc tunnel are discussed in this paper. Experiments are performed in the H11DF arc tunnel by two diagnostic methods which are the microwave method and

the probe method. From the experiments, the effects of ablative products from the heat-protection material upon the electron concentration in the flow field and upon the transmission of the electromagnetic wave and the effect of the injection of different electrophilic reagents upon the electron concentration in the flow field are determined. This has provided the basis for selecting the heat-protection materials and determining their properties. GRA

N86-30043# Princeton Univ., N. J. Dept. of Electrical Engineering and Computer Science.
EFFICIENT ALGORITHMS AND STRUCTURES FOR ROBUST SIGNAL PROCESSING Interim Report, 30 Sep. 1984 - 27 Apr. 1985
Bradley W. Dickinson 14 May 1985 7 p
(Grant AF-AFOSR-0381-84)
(AD-A166147; AFOSR-86-0040TR) Avail: NTIS HC A02/MF A01 CSCL 17/2

During the past 7 months, the research efforts supported by this grant have concentrated on robust estimation techniques for autoregressive models and some related system theoretic problems associated with parameter estimation problems for time series models. The motivation for this work arises from applications in signal processing such as linear predictive signal modeling, signal detection, and spectral analysis. The overall goal of this research has been to put together ideas and techniques from statistics, signal processing, and system theory to bring new perspectives to such problems. GRA

N86-30044# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DATA TRANSMISSION SYSTEMS CIRCUITS AND EXCHANGE PARAMETERS ON THE C3 INTERFACE IN THE CASE OF THE PARALLEL INPUT-OUTPUT OF DISCRETE INFORMATION
19 Mar. 1986 26 p Transl. into ENGLISH of Gos. Obshchesoyuznyy Standart 18146-72 (USSR), 1972 p 1-20
(AD-A166206; FTD-ID(RS)T-0208-86) Avail: NTIS HC A03/MF A01 CSCL 17/2

The present standard extends to interface circuits between terminal data equipment (OOD) and data transmission equipment (APD), containing an error protection device (UZO), in the case of parallel character-by-character input-output of data and the radial method of information exchange. The standard establishes the nomenclature of interface circuits, the electrical parameters of the signals sent by way of these circuits, and the technical requirements. GRA

N86-30045# Rome Air Development Center, Griffiss AFB, N.Y.
A REVIEW OF PHASE-ONLY SIDELOBE NULLING INVESTIGATIONS AT RADC (ROME AIR DEVELOPMENT CENTER) Report, Jan. - Jul. 1985
Robert A. Shore Aug. 1985 29 p
(AD-A166602; RADC-TR-85-145) Avail: NTIS HC A03/MF A01 CSCL 09/5

A review is presented of work performed at RADC on the subject of phase-only null synthesis and adaptive nulling in the sidelobes of linear array antenna patterns. Beam space representations are used in much of this work. Related investigations outside RADC are summarized, and a general bibliography of phase-only pattern control investigations is included. GRA

N86-30046# Naval Research Lab., Washington, D. C.
MULTICHANNEL RELATIVE-ENTROPY SPECTRUM ANALYSIS Memorandum Report, Oct. 1983 - Oct. 1985
R. W. Johnson and B. R. Musicus 25 Mar. 1986 25 p
(AD-A166625; NRL-MR-5723) Avail: NTIS HC A02/MF A01 CSCL 09/4

A new relative-entropy method is presented for estimating the power spectral density matrix for multichannel data, given correlation values for linear combinations of the channels, and given an initial estimate of the spectral density matrix. A derivation of the method from the relative-entropy principle is given. The basic approach is similar in spirit to Multisignal Relative Entropy Spectrum Analysis, but the results differ significantly because the present method does not arbitrarily require the final distributions of the various channels to be independent. For the special case of separately estimating the spectra of the signal and noise, given the correlations to their sum, Multichannel Relative Entropy Spectrum Analysis turns into a two stage procedure. First a smooth power spectrum model is fitted to the correlations of the signal plus noise. Then final estimates of the spectra and cross spectra are obtained through linear filtering. For the special case where p uniformly spaced correlations are known, and where the initial estimate of the signal plus noise spectrum is all-pole with order p or less, this method fits a standard Maximum Entropy autoregressive spectrum to the noisy correlations, then linearly filters to calculate the signal and noise spectra and cross spectra. Consideration is given to the case where only an initial estimate of the noise power spectrum is available. An illustrative numerical example is given. GRA

N86-30047# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
ROUND ROBIN SCHEDULING FOR FAIR FLOW CONTROL IN DATA COMMUNICATION NETWORKS
Ellen L. Hahne and Robert G. Gallager Mar. 1986 14 p Presented at the IEEE International Conference on Communications, Jun. 1986 Sponsored in part by AT and T Bell Labs.
(Contract N00014-84-K-0357; Grant NSF ECS-83-10698; DARPA Order-3045; ONR Proj. 049-383)
(AD-A166728; LIDS-P-1537) Avail: NTIS HC A02/MF A01 CSCL 17/2

Round robin link scheduling, in conjunction with conventional window flow control, can be used to achieve throughput fairness in point-to-point packet networks with virtual circuit routing. Consider a data communication network consisting of store-and-forward nodes joined by point-to-point links. Each user session is assigned a fixed path (often called a virtual circuit) through the network, and data for the session are sent in packets along this path. In such a network it is possible for the incoming traffic rate at a node to exceed the outgoing rate, causing a data queue to build up at that node. This queue may eventually overflow the node's storage space, or the delay of acknowledgements may cause transmitters to assume that data were lost. These problems result in wasteful retransmission that effectively reduce the capacity of the network. Flow control procedures attempt to prevent or alleviate this degradation by regulating the appropriate traffic sources. GRA

N86-30048# Rome Air Development Center, Griffiss AFB, N.Y.
PROCEEDINGS OF THE 1985 ANTENNA APPLICATIONS SYMPOSIUM, VOLUME 1
Dec. 1985 337 p Symposium held at Urbana, Ill.
(AD-A166754; RADC-TR-85-242-Vol-1) Avail: NTIS HC A15/MF A01 CSCL 09/5

The Proceedings of the 1985 Antenna Applications Symposium is a collection of state-of-the-art papers relating to phased array antennas, multibeam antennas, satellite antennas, microstrip antennas, reflectors antennas, HF, VHF, UHF an various other antennas. GRA

N86-30049# Department of the Navy, Washington, D. C.
WIDE-BAND DISTRIBUTED RF COUPLER Patent
Larry R. Barnett, Yue-Ying Lau, Kwo C. Chu, and L. Granatstein, inventors (to Navy) Issued 28 Jan. 1986 16 p Supersedes AD-D009782
(AD-D012214; US-Patent-4,567,401; US-Patent-Appl-SN-389132; US-Patent-Class-315-5) Avail: NTIS Avail: US Patent and Trademark Office CSCL 09/1

A wide-band distributed coupler for coupling rf energy from and input waveguide into a tapered interaction waveguide in a traveling-wave amplifier comprising a plurality of channel filters connecting between the input and interaction waveguides, with each filter coupled to the interaction waveguide at the appropriate cross-sectional position along its tapered length where the interaction waveguide cutoff frequency approximately matches the wave frequency propagated by the filter is discussed. Each filter

comprises, in one embodiment, a main coaxial cavity tuned to a distinct center frequency, a first simple isolation cavity for coupling rf energy between the input waveguide and the main cavity, and at least one second simple isolation cavity for coupling energy between the main cavity and the tapered interaction waveguide.
Author (GRA)

N86-30050# Department of the Air Force, Washington, D.C.
ADAPTIVE MICROWAVE CHANNELIZATION Patent Application
Ronald W. Minarik, inventor (to Air Force) Filed 15 Jan. 1986 15 p
(AD-D012215; US-Patent-Appl-SN-819073) Avail: NTIS HC A02/MF A01 CSCL 09/1

A signal processing system is disclosed that divides a broad band of input signals into separate channels separated by stopbands and permits operation in the crossover frequencies occuring at these stopbands. A triplexer separator recieves and divides the broad band of input signals into a first, second and third band of signals, and sends them respectively to a first, second and third signal channel. The first and third signal channels are narrow bands which respectively occur at the lower and upper frequency end of the broad band of input signals. The second signal channel is identical to the broad band of input signals. In normal operation the first, second and third signal channels separately and independently conduct their respective signals to a triplexer combiner, where they are recombined. However, if signal processing is planned at crossover frequencies in the stopbands of either the first or third signal channel, the first or third band of signals can be directed into the second signal channel to permit such operation.
GRA

N86-30051# Department of the Air Force, Washington, D.C.
TEST CONFIGURATION AND PROCEDURE FOR DETERMINING THE OPERATIONAL STATUS OF A PHASED ARRAY ANTENNA Patent Application
Stephen V. Zezuto, inventor (to Air Force) Filed 15 Jan. 1986 14 p
(AD-D012216; US-Patent-Appl-SN-818924) Avail: NTIS HC A02/MF A01 CSCL 09/5

The operational status of individual phase control modules within a phased array antenna can be determined using a radio frequency oscillator, a directional coupler, a spiral antenna, an attenuator, a harmonic frequency converter, a network analyzer, and a phase magnitude display. The radio frequency oscillator generates a test radio frequency signal which is conducted into the sum port of the array by the directional coupler. The phase control modules normaly phase shift radio frequency signals they receive from the sum port by amounts indicated in a command signal from the radar control system. When using this test system, the radar control system should be directed to send a test command signal which direct the phase control modules to repeatedly phase shift received radio frequency signals between a first and second phase state. The spiral antenna, when placed in proximity of each individual phase control module, receives and conducts phase shifted radio frequency signals to the harmonic analyzer. The harmonic analyzer samples and conducts the phase shifted radio frequency signals in to the network analyzer for comparison. When the first phase state is 180, deg the display, which receives the output of the network analyzer clearly indicates if the phase control module is phase shifting the radio frequency signal in response to the test command signal.
Author (GRA)

N86-30052# Department of the Navy, Washington, D. C.
DUAL SCAN RATE RADAR Patent
William M. Waters, inventor (to Navy) Issued 25 Feb. 1986 6 p Supersedes AD-D010190
(AD-D012221; US-Patent-4,573,050; US-Patent-Appl-SN-467421; US-Patent-Class-343-17.1R) Avail: NTIS Avail: US Patent and Trademark Office CSCL 17/9

A dual scan rate radar system (DSR) includes a phased array antenna, a transmitter, a receiver and a control unit. Each rf pulse from the transmitter includes contiguous long-range and short-range pulses. The control unit adjusts the antenna so that the long-range pulse is transmitted into a slow beam at theta s and the short-range pulse is transmitted into a fast beam at theta F. The control unit also adjusts the antenna to receive the short-range pulse echos during a first part of the interpulse interval and the long-range pulse echos during a second part of the interpulse interval. The angles theta S and theta F are varied so that the slow and fast beam are scanned at dual rates RS and RF, respectively, where RS < RF.
GRA

N86-30053# Department of the Army, Washington, D. C.
RANDOM BEAM POSITIONING SURVEILLANCE PROCESS Patent Application
Michael G. Allen, Howard Feacher, and Dennis McCallam, inventors (to Army) Filed 18 Feb. 1986 18 p
(AD-D012251; US-Patent-Appl-SN-841083) Avail: NTIS HC A02/MF A01 CSCL 09/5

Random beam positioning for an E-scan radar system having an electronically steerable antenna is controlled by a digital computer which is programmed to generate lists or files of portions of the desired area of surveillance. Two separate lists are generated corresponding to the forward and rear portions of the area of coverage. These lists are thereafter independently randomized and combined to generate beam position commands for the desired surveillance region, thereby providing full radar coverage over a desired region while decreasing the probability of being tracked by an undesired detector.
GRA

N86-30054# Oak Ridge National Lab., Tenn.
ELECTROMAGNETIC FIELDS IN 3-D FOR VARIOUS CAVITY ANTENNAS AND FARADAY SHIELDS
G. L. Chen, J. H. Whealton, R. W. McGaffey, R. J. Raridon, M. A. Bell, E. F. Jaeger, and D. J. Hoffman 16 Dec. 1985 21 p
(Contract DE-AC05-84OR-21400)
(DE86-007563; DOE/OR-21400/T244) Avail: NTIS HC A02/MF A01

Maxwell's equations are solved for vectors E and H for various cavities of interest. The results are shown to be in agreement with existing theory for the fundamental resonance of a long ridge wave guide. This analysis has been applied to the testing cavity antenna for D-III. The method can include the addition of an arbitrarily-shaped Faraday shield. We have explored the electromagnetic effects of Faraday shield by measurement and computation. This correlation of theory and experiments is then used to predict power limits of an antenna by voltage- and current-limitations.
DOE

N86-30055# Sao Paulo Univ. (Brazil). Inst. de Fisica.
TIME DEPENDENT VARIATIONAL DESCRIPTION OF ONE-DIMENSIONAL INELASTIC SCATTERING
M. A. M. deAgular and C. P. Malta 1985 23 p
(DE86-700610; IFUSP-P-510) Avail: NTIS (US Sales Only) HC A02/MF A01

The time dependent variational principle is applied to generate semi-classical approximations in the description of inelastic collisions in one-dimension. This is achieved by using appropriately parametrized trial wave functions. The method is applied to an exactly solvable model and the results are fairly good, in general much better than other approximate calculations.
DOE

N86-30056# Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
STUDY OF MULTIPATH FADING IN LINE OF SIGHT RADIO LINKS: BIBLIOGRAPHY SUMMARY [ETUDE DES TRAJETS MULTIPLES SUR LES LIAISONS EN VISIBILITE: SYNTHESE BIBLIOGRAPHIQUE]
M. Sylvain Jun. 1984 265 p In FRENCH
(CRPE-NT-133; ESA-86-97188) Avail: NTIS HC A12/MF A01

Radio signal fading at fixed frequency; fixed frequency statistics with channel diversity; space diversity and frequency diversity effects on single frequency transmission; frequency selectivity in multipath transmission; models describing the contribution of

meteorological factors to multipath fading; and multipath consequences and the means to reduce effects are discussed. ESA

N86-30057# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
A SATELLITE BROADCAST RECEIVING TERMINAL
S. H. Mneney Mar. 1984 31 p Sponsored by NUFFIC
(ESA-86-97317) Avail: NTIS HC A03/MF A01

Input and output requirements, the design, and the construction of a satellite Earth station for reception of television and radio signals in remote rural communities, from a satellite with a strong beam are described. The station receives from the GORIZONT-2 satellite at 4 GHz. Television and radio broadcasts are received at Eindhoven (Netherlands) from the All-Union station in Moscow. Other, weaker, stations can be received, albeit less clearly, from other transponders of GORIZONT-2 and GORIZONT-3 satellites. The same receiver, placed in other locations, can be used to receive from satellites operating at S or C-band, such as the INSAT or Arabsat. ESA

N86-30058# Technische Hogeschool, Eindhoven (Netherlands). Onderafdel. der Wiskunde en Informatica.
FIELD CALCULATIONS OF AXISYMMETRIC CURRENT COILS IN VACUUM [VELDBEREKENINGEN AAN AXIAAL-SYMMETRISCHE STROOMSPOELEN IN VACUUEM]
M. A. J. Voermans 1985 106 p In DUTCH
(ESA-86-97547) Avail: NTIS HC A06/MF A01

Expressions for the magnetic induction of the field resulting from an axisymmetric current configuration were mutually related. Expressions with elliptic integrals and Legendre functions series for singular circular coils and circle cylindric current films are given. For voluminous circle cylindric current coils, only expressions in Legendre functions series and the form of integrals are known. By an appropriate bifurcation of the integral interval, the induction in each point of the voluminous coil was calculated. The homopolar direct current generator with superconducting coil packet was examined. ESA

N86-30059# Technische Hogeschool, Delft (Netherlands). Microwave Lab.
THE DELFT UNIVERSITY OF TECHNOLOGY SCATTEROMETER (DUTSCAT) REPORT Status Report
Paul Snoeij 9 Jul. 1984 7 p
(ESA-86-97550) Avail: NTIS HC A02/MF A01

Internal and external calibration of a C band wind scatterometer for ESA is outlined. Final results are not available. ESA

N86-30060# Technische Hogeschool, Delft (Netherlands). Microwave Lab.
THE ESA C-BAND WIND SCATTEROMETER CAMPAIGN: PRELIMINARY CAMPAIGN DEFINITION
G. P. deLoor and E. P. W. Attema May 1984 86 p
(ESA-86-97552) Avail: NTIS HC A05/MF A01

Data on radar cross sections, and equipment in Europe for the wind scatterometer campaign defined by ESA are described. The experiment consists of a preliminary campaign performed by the member nations themselves and a grouped main campaign. Problems which need immediate attention are calibration (intercalibration on the antenna-range of ESTEC or calibration over a land target) and data delivery time and the format problem. ESA

N86-30061# Technische Hogeschool, Delft (Netherlands). Dept. of Electrical Engineering.
THE ESA C-BAND WIND SCATTEROMETER CAMPAIGN: DATA PROCESSING Second Progress Report
Otto Rompelman and Paul Snoeij Jan. 1985 13 p Sponsored by Netherlands Remote Sensing Board
(Contract ESTEC-5633/83-NL-MD)
(ESA-86-97555) Avail: NTIS HC A02/MF A01

The ESA C-band wind scatterometer was calibrated using reflected power data. A technique for roll correction was developed. The calibrating and roll-corrected data were resampled to obtain a data format which meets ESA requirements. ESA

N86-30062# Technische Hogeschool, Delft (Netherlands). Vakgroep Microgolftechniek.
INTERNAL SIDE-LOOKING AIRBORNE RADAR (SLAR) CALIBRATION [INTERNE SLAR CALIBRATIE]
P. Snoeij Nov. 1985 12 p In DUTCH Sponsored by Netherlands Remote Sensing Board
(I85.68220.002; BCRS-85-03; ESA-86-97558) Avail: NTIS HC A02/MF A01

A one-point internal calibration in a SLAR was developed. Radiometric calibration is necessary if the SLAR is used for remote sensing applications. The calibration signal was injected between the T/R cell (a switch to protect the mixer/preamplifier combination against transmission pulse overcharges) and the mixer using a delay line to abolish the impact of the T/R switching time. Measurements show good results. ESA

N86-30063# Technische Hogeschool, Delft (Netherlands). Vakgroep Microgolftechniek.
WAVE OBSERVATION AT SEA WITH THE DUTCH SIDE-LOOKING AIRBORNE RADAR (SLAR) [GOLFWAARNEMING OP ZEE MET DE NEDERLANDSE SLAR (SIDE-LOOKING AIRBORNE RADAR)]
H. C. Peters Mar. 1984 31 p In DUTCH Sponsored by Netherlands Remote Sensing Board
(I83.533.005; ESA-86-97559) Avail: NTIS HC A03/MF A01

Theoretical limits for sea wave observation with SLAR systems were investigated by modeling the interaction between microwave radiation and the sea surface. A description of the SLAR, in which three-dimensional spatial wave extension, two-dimensional antenna variations, pulse modulation, and platform movements are assimilated is given. A two-dimensional collection of equidistant point objects for microwave scattering at the rough sea surface is given. Resolution characteristics and speckle behavior were analyzed. Spatial resolution in range and azimuth is limited by pulse width and azimuth aperture angle of the antenna. As the modulation transfer function amplitude has a low value, small variations are lost in noise and speckle. Image error as a result of the observation of moving wave patterns with a flying radar are discussed. Recommendations to improve the radar characteristics are given. ESA

N86-30064# Joint Publications Research Service, Arlington, Va.
WORLDWIDE REPORT: TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT
28 Apr. 1986 64 p Transl. into ENGLISH from various worldwide articles
(JPRS-TTP-86-011) Avail: NTIS HC A04/MF A01

Telecommunication topics addressed include: fiber optics, satellite communications, bids for construction of the Anik E Satellite, trillium telephone marketing, digital equipment, remote sensing, television relay stations, digital phone systems, and microwave links. For individual titles, see N86-30065 through N86-30066.

N86-30065# Joint Publications Research Service, Arlington, Va.
CHINA'S SATELLITE COMMUNICATIONS DISCUSSED
Zong Ruhou *In its* Worldwide Report: Telecommunications Policy, Research and Development (JPRS-TTP-86-011) 28 Apr. 1986 p 1-6 Transl. into ENGLISH from Xiandaihua (Beijing, China), v. 8, no. 1, 25 Jan. 1986 p 21 (For primary document see N86-30064 21-32)
Avail: NTIS HC A04/MF A01

In 1972, China began to enter the age of satellite comunications, and it was realized that satellites could play a large role in television transmission in China. The experimental broadcasting of satellite television programs was begun in 1978, and satisfactory results were obtained. The success of the television transmission demonstration has led to important decisions regarding development of a domestic satellite communications system. Before specialized communications satellites are launched, the decision was made to lease an international communications satellite transmitter. The responsibility of the ground stations were discussed. B.G.

N86-30066# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT OF CHINA'S FIBER OPTIC TECHNOLOGY DISCUSSED
Qizhang Bai *In its* Worldwide Report: Telecommunications Policy, Research and Development (JPRS-TTP-86-011) 28 Apr. 1986 p 7-9 Transl. into ENGLISH from Xiandaihua (Beijing, China), v.8, no. 1, 25 Jan. 1986 p 17 (For primary document see N86-30064 21-32)
Avail: NTIS HC A04/MF A01

Fiber optic technology is a new transmission technology having the outstanding advantages of low loss, high capacity, no magnetic interference, all-dielectric transmission, small size, and light weight. Research into fiber optic technology began in the mid-1970's in China. The scope of applications for fiber optic communications systems is divided into three categories: junction lines, trunk lines, and subscriber lines. Each of the categories are briefly discussed. The advantages and economic suitability of fiber optics are discussed. B.G.

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N86-30067# Royal Signals and Radar Establishment, Malvern (England).
A STUDY OF GROUP-TYPE SINGLE-PHASE UNIDIRECTIONAL SAW TRANSDUCERS ON LINbO3 AND QUARTZ
M. F. Lewis Jun. 1985 51 p
(AD-A165670; RSRE-MEMO-3833; BR98351; ESA-86-97114)
Avail: NTIS HC A04/MF A01

A development of the single phase unidirectional transducer concept which employs sampled transducers to allow the introduction of reflector banks within the transducers is discussed. The fabrication of such devices requires a single stage of photolithography. Prototypes show very encouraging passband characteristics with an insertion loss $<$ 3 dB on LiNbO3 at 100 MHz, and $<$ 6 dB on quartz at 400 MHz. In each case the amplitude response is essentially ripple-free, and the phase characteristic linear. ESA

N86-30068*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYTESS 2: A HYPOTHETICAL TURBOFAN ENGINE SIMPLIFIED SIMULATION WITH MULTIVARIABLE CONTROL AND SENSOR ANALYTICAL REDUNDANCY
Walter C. Merrill Jun. 1986 39 p
(NASA-TM-87344; E-3014; NAS 1.15:87344) Avail: NTIS HC A03/MF A01 CSCL 21E

A hypothetical turbofan engine simplified simulation with a multivariable control and sensor failure detection, isolation, and accommodation logic (HYTESS II) is presented. The digital program, written in FORTRAN, is self-contained, efficient, realistic and easily used. Simulated engine dynamics were developed from linearized operating point models. However, essential nonlinear effects are retained. The simulation is representative of the hypothetical, low bypass ratio turbofan engine with an advanced control and failure detection logic. Included is a description of the engine dynamics, the control algorithm, and the sensor failure detection logic. Details of the simulation including block diagrams, variable descriptions, common block definitions, subroutine descriptions, and input requirements are given. Example simulation results are also presented. Author

N86-30069*# California Univ., Los Angeles. Dept. of Electrical Engineering.
A SURVEY OF THE STATE OF THE ART AND FOCUSED RESEARCH IN RANGE SYSTEMS, TASK 2 Semiannual Report
Kung Yao Jun. 1986 22 p
(Grant NAG2-304)
(NASA-CR-176988; NAS 1.26:176988) Avail: NTIS HC A02/MF A01 CSCL 09C

Contract generated publications are compiled which describe the research activities for the reporting period. Study topics include: equivalent configurations of systolic arrays; least squares estimation algorithms with systolic array architectures; modeling and equilization of nonlinear bandlimited satellite channels; and least squares estimation and Kalman filtering by systolic arrays. For individual titles, see N86-30070 through N86-30072.

N86-30070*# California Univ., Los Angeles. Dept. of Electrical Engineering.
ON SOME EQUIVALENT CONFIGURATIONS OF SYSTOLIC ARRAYS
C. Y. Chang and K. Yao *In its* A Survey of the State-of-the-Art and Focused Research in Range Systems, Task 2 Jun. 1986 5 p (For primary document see N86-30069 21-33)
Avail: NTIS HC A02/MF A01 CSCL 09C

A systematic approach is presented for designing systolic arrays and their equivalent configurations for certain general classes of recursively formulated algorithms. A new method is also introduced to reduce the input bandwidth and storage requirements of the systolic arrays through the study of dependence among the input data. Many well known systolic arrays can be rederived and also many new systolic arrays can be discovered by this approach. Author

N86-30071*# California Univ., Los Angeles. Dept. of Electrical Engineering.
MODELING AND EQUALIZATION OF NONLINEAR BANDLIMITED SATELLITE CHANNELS
K. Konstantinides (Hewlett-Packard Co., Palo Alto, Calif.) and K. Yao *In its* A Survey of the State-of-the-Art and Focused Research in Range Systems, Task 2 Jun. 1986 5 p (For primary document see N86-30069 21-33)
Avail: NTIS HC A02/MF A01 CSCL 09C

The problem of modeling and equalization of a nonlinear satellite channel is considered. The channel is assumed to be bandlimited and exhibits both amplitude and phase nonlinearities. A discrete time satellite link is modeled under both uplink and downlink white Gaussian noise. Under conditions of practical interest, a simple and computationally efficient design technique for the minimum mean square error linear equalizer is presented. The bit error probability and some numerical results for a binary phase shift keyed (BPSK) system demonstrate that the proposed equalization technique outperforms standard linear receiver structures. M.G.

N86-30072*# California Univ., Los Angeles.
ON REALIZATIONS OF LEAST-SQUARES ESTIMATION AND KALMAN FILTERING BY SYSTOLIC ARRAYS
M. J. Chen and K. Yao *In its* A Survey of the State-of-the-Art and Focused Research in Range Systems, Task 2 Jun. 1986 10 p (For primary document see N86-30069 21-33)
Avail: NTIS HC A02/MF A01 CSCL 09C

Least-squares (LS) estimation is a basic operation in many signal processing problems. Given $y = Ax + v$, where A is a m x n coefficient matrix, y is a m x 1 observation vector, and v is a m x 1 zero mean white noise vector, a simple least-squares solution is finding the estimated vector x which minimizes the norm of /Ax-y/. It is well known that for an ill-conditioned matrix A, solving least-squares problems by orthogonal triangular (QR) decomposition and back substitution has robust numerical properties under finite word length effect since 2-norm is preserved. Many fast algorithms have been proposed and applied to systolic arrays. Gentleman-Kung (1981) first presented the trianglular systolic array for a basic Givens reduction. McWhirter (1983) used this array structure to find the least-squares estimation errors. Then by geometric approach, several different systolic array realizations of the recursive least-squares estimation algorithms of Lee et al (1981)

were derived by Kalson-Yao (1985). Basic QR decomposition algorithms are considered in this paper and it is found that under a one-row time updating situation, the Householder transformation degenerates to a simple Givens reduction. Next, an improved least-squares estimation algorithm is derived by considering a modified version of fast Givens reduction. From this approach, the basic relationship between Givens reduction and Modified-Gram-Schmidt transformation can easily be understood. This improved algorithm also has simpler computational and inter-cell connection complexities while compared with other known least-squares algorithms and is more realistic for systolic array implementation. M.G.

N86-30073*# Westinghouse Research and Development Center, Pittsburgh, Pa.
DOUBLE-INJECTION, DEEP-IMPURITY SWITCH DEVELOPMENT Final Report, 27 Feb. 1984 - 28 Feb. 1985
D. W. Whitson 28 Mar. 1985 120 p
(Contract NAS3-23882)
(NASA-CR-174936; NAS 1.26:174936; WRDC-85-9F4-DIDIS-R1) Avail: NTIS HC A06/MF A01 CSCL 09A

The overall objective of this program was the development of device design and process techniques for the fabrication of a double-injection, deep-impurity (DI) sup 2 silicon switch that operates in the 2-10 kV range with conduction current values of 5 A at 2 kV and 1 A at 10 kV. Other major specifications include a holding voltage of 10 V with no gate current, 10 microsec switching time, and power dissipation of 50 W at 75 C. It was decided to concentrate on the lateral circular devices in order to optimize the gold diffusion. This resulted in devices that are much better switches (approx.1 micro sec switching time), and in a gold diffusion process that is much more controllable than those previously developed. Some results with injection-gated devices were also obtained. The current conduction for V less than VT was analyzed and seen to agree, for the most part, with Lampert's theory. Various sections of this report describe the device designs, wafer-processing techniques, and various measurements which include ac and dc characteristics and four-point probe. Author

N86-30074# DRF, Inc., Soquel, Calif.
ADAPTIVE CONTROL SYSTEM. VOLUME 1. EQUIPMENT AND TESTING Final Report, May 1983 - Mar. 1985
Abraham M. Fuchs Jan. 1986 136 p
(Contract F33615-83-C-3203)
(AD-A166036; AFWAL-TR-85-3095-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 09/3

This final report describes a two year effort to enhance the dynamic response of the load electro-hydraulic control systems used in fatigue testing by a combination of adding control functions of resonance compensation, integral control, and feedforward to the electronic controller; making frequency response measurements of the open-loop control system as a basis for closed loop adjustment; and using a small computer to assist in the optimum adjustment of the control equipments. Hardware was developed and produced for three systems including computer controlled frequency response analyzer, and manual or computer setup controller, resonance compensation and manual integral control and feedforward networks. Software was developed to make the frequency response measurements, to optimize system adjustments, to set the control hardware, and to make on-line digital data taking and data reduction possible. The individual components and the overall system was demonstrated and upgraded by application to real test setups in the Structures Test Laboratory. Significant improvements in dynamic performance and run time were achieved. Adaptive setup and on-line adjustment are now possible. Author (GRA)

N86-30075# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MACROMODELING AND OPTIMIZATION OF DIGITAL MOS VLSI CIRCUITS
Mark D. Matson and Lance A. Glasser Mar. 1986 46 p
(Contracts N00014-80-C-0622; F49620-84-C-0004)
(AD-A166658; VLSI-MEMO-86-303) Avail: NTIS HC A03/MF A01 CSCL 09/5

Power consumption and signal delay are crucial to the design of high-performance VLSI circuits. This paper presents CAD tools for modeling and optimizing digital MOS designs. The tools determine the transistor sizes that minimize circuit power consumption subject to constraints on signal path delays. Computational efficiency is obtained through macromodeling techniques and a specialized optimization algorithm. The macromodels are based on device equations, and encapsulate logic gate behavior in a set of simple yet accurate formulas. The optimization algorithm exploits properties of the digital MOS domain to convert the primal optimization problem into a dual form which is much easier to solve. The result is a pair of CAD tools that can optimize a circuit in roughly the amount of time needed to perform a transistor level simulation of the circuit. Author (GRA)

N86-30076# Department of the Air Force, Washington, D.C.
MONOLITHIC LOW NOISE AMPLIFIER WITH LIMITING Patent Application
James P. Young, inventor (to Air Force) Filed 27 Jan. 1986 15 p
(AD-D012225; US-Patent-Appl-SN-822579) Avail: NTIS HC A02/MF A01 CSCL 09/5

A single circuit which provides forward biasing, input impedance matching and voltage input limiting to a transistor which has a source, gate and drain terminal is presented. Biasing, input matching and limiting for a transistor is accomplished using two inductor coils, five crystal diodes, a positive voltage source, and three resistors. The forward biasing is achieved using three resistors, and the third, fourth and fifth crystal diode. The third resistor connects the drain terminal of the transistor to the positive voltage source. The second resistor connects the junction between the third resistor and the drain terminal to the transistor's gate terminal. The fourth and fifth crystal diodes are connected in series between the source terminal and the common electrical ground. The first resistor and third diode are connected in parallel between the transistor's gate terminal and the common electrical ground. Limiting of the input voltages over the gate terminal is accomplished by the first and second crystal diodes which are connected in series with each other and in a parallel circui t with the first resistor 1 diode and the common electrical ground. GRA

N86-30077# Department of the Air Force, Washington, D.C.
LOW PHASE NOISE TWO PORT VOLTAGE CONTROLLED OSCILLATOR Patent Application
Watkins and Staley, inventors (to Air Force) Filed 6 Jan. 1986 35 p
(AD-D012234; US-Patent-Appl-SN-816596) Avail: NTIS HC A03/MF A01 CSCL 09/5

A low noise two port voltage controlled oscillator apparatus having a coarse tuning circuit serially connected to an inductor to form a resonant circuit is described. A fine tuning circuit is serially connected between the resonant circuit and the input to the amplifier. A large capacitance series silicon varactor minimizes noise at the frequency of operation while optimizing the coarse tuning range. GRA

N86-30078# Department of the Air Force, Washington, D.C.
MICRO MUSHROOM INSTRUMENTATION SYSTEM Patent Application
Walter F. Davidson, inventor (to Air Force) Filed 15 Jan. 1986 48 p
(AD-D012235; US-Patent-Appl-SN-818945) Avail: NTIS HC A03/MF A01 CSCL 20/6

An electronics circuit which provides for the recording of instrumentation data on an optical disk is disclosed. The optical disk is formatted in a spiral format instead of concentric tracks. The spiral format allows data to be recorded without the gaps that would be associated with concentric tracks. The instrumentation system provides each channel with a program instrumentation amplifier, a six pole lowpass switched capacitor filter, a sample and hold amplifier, and a digital to analog converter to provide

automatic offset capability. Since each channel has its own components, simultaneous samples of every channel can be captured. All of the input signal's channel variables can be captured. All of the input signal's channel variables can be changed under software control without hardware changes. A single board computer is used for a system controller. GRA

N86-30079# Department of the Air Force, Washington, D.C.
PULSE REPETITION MODULATOR APPARATUS Patent Application
Steinmayer, inventor (to Air Force) 3 Feb. 1986 22 p
(AD-D012237; US-Patent-Appl-SN-824998) Avail: NTIS HC A02/MF A01 CSCL 17/2

A pulse repetition modulator apparatus is described which is comprised of a pulse width modulator to supply a series of maximum transmitter power output bursts that have been generated with a pulse time correlation to the sampled amplitude of the voice signal input to the link. The output bursts would therefore be of variable length with the durations proportional to the amplitude of the voice input signal. GRA

N86-30080# Argonne National Lab., Ill.
FIRST INTERNATIONAL WORKSHOP ON BATTERY TESTING, 30 SEPTEMBER-2 OCTOBER 1985, HEIDELBERG, FRG Summary Report
F. Hornstra 1985 4 p Workshop held at the Annual Battery and Electrochemical Energy Storage Contractors' Meeting, Washington, D.C., 18 Nov. 1985
(Contract W-31-109-eng-38)
(DE86-004058; CONF-851146-3) Avail: NTIS HC A02/MF A01

In June 1984, after the last Contractor's Conference, representatives from several countries met in Washington, DC to discuss international cooperation in advanced battery research and development. Because of the diversity of approaches in various countries and the minimum attentien in international forums for battery testing, the representatives agreed on the desirability of a workshop to discuss testing methodologies. As a result, the first International Workshop on Battery Testing was organized and held in Heidelberg, Germany from 30 September through 2 October 1985. DOE

N86-30081# Argonne National Lab., Ill.
INVESTIGATION OF ALTERNATIVE MCFC CATHODE MATERIALS AT ARGONNE NATIONAL LABORATORY
R. D. Pierce and J. L. Smith 1986 6 p Presented at the International Symposium on Fuel Cell and Advanced Battery, Tokyo, Japan, 22 Jan. 1986
(Contract W-31-109-eng-38)
(DE86-005576; CONF-860138-1) Avail: NTIS HC A02/MF A01

The conventional cathode material for a molten carbonate fuel cell (MCFC) is NiO. However, these cathodes have limited longevity due to dissolution at cathode conditions and precipitation as metal at anode conditions. Alternative cathode materials are being sought through a process of identifying stable materials in the cathode environment, evaluating their properties, and modifying their conductivity through doping. The work has centered on LiFeO2 and Li2MnO3 which are stable, have low solubility, and do not migrate under cell conditions. LiFeO2 can be produced with resistivity in the range of 10 to 40 ohm-cm at 650(0)C in realistic cathode gases. DOE

N86-30082# Lawrence Livermore National Lab., Calif.
POINTING ALIGNMENT BY ORTHOGONAL PHASE-LOCK FEEDBACK LOOPS
M. C. Rushford and P. J. Kuzmenko 25 Nov. 1985 8 p Presented at the Los Angeles Symposium and Exhibition on Optical and Electro-Optical Engineering, Los Angeles, Calif., 19 Jan. 1986
(Contract W-7405-eng-48)
(DE86-006707; UCRL-91874; CONF-860117-4) Avail: NTIS HC A02/MF A01

Orthogonally acting phase-locked loops operating at distinct, well-separated dither frequencies are used to automatically align (maximize output power) an argon ion pump laser, its pointing into a ring dye laser, and optimize a dye laser beam coupling into a single mode fiber of 4 micron core diameter. Such a system of feedback loops or combination of them is an ATOM (Alignment Through Orthogonal Maxima). DOE

N86-30083# Los Alamos National Lab., N. Mex.
ELECTRONICS DIVISION RESEARCH AND DEVELOPMENT Progress Report, 1 Oct. 1984 - 30 Sep. 1985
C. Spirio, comp. and E. Courtney, comp. Jan. 1986 205 p
(Contract W-7405-eng-36)
(DE86-008327; LA-10656-PR) Avail: NTIS HC A10/MF A01

This report describes progress in continuing research and development activities and presents new technical initiatives that the Electronics Division at Los Alamos National Laboratory has undertaken in FY 1985. Much of this work is carried out under sponsorship of the Laboratory's internal supporting research and development program. Five technology areas form the focus of this work and consist of research in: (1) solid state/optoelectronics, (2) hardened electronics, (3) defense electronics systems, (4) fuel cell power sources, and (5) computer-aided engineering. This report is fourth in an annual series. DOE

N86-30084# Tri-Univ. Meson Facility, Vancouver (British Columbia).
500 MHZ CCD SERIAL ANALOG MEMORY
J. Cresswell, I. Carvahlo, M. LeNoble, A. Benolo (Communications Research Centre, Ottawa (Ontario).), and R. Kule Oct. 1985 2 p Presented at the IEEE Nuclear Science Symposium, San Francisco, Calif., 23 Oct. 1985 Prepared in cooperation with Communications Research Centre, Ottawa, Ontario (Canada).
(DE86-901019; TRI-PP-85-96; CONF-851009-67) Avail: NTIS (US Sales Only) HC A02/MF A01

The design of a GaAs charge coupled device as a solution to transient recording of electrical signals is discussed. The requirements of Experiment 787 and others require the analysis of signals with a 250 MHz bandwidth. Some initial results of the work are presented. DOE

N86-30085# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
A FAST HIGH POWER LIGHT PULSE GENERATOR [EIN SCHNELLER LICHTPULSGENERATOR HOHER LEISTUNG]
W. J. Hiller, H.-M. Lent, G. E. A. Meier, and B. Stasicki Jul. 1984 15 p In GERMAN
(MPIS-18/1985; ISSN-0436-1199; ESA-86-96904) Avail: NTIS HC A02/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15

A device for the production of flashes for high speed photography was developed. Light diodes were used as the light source. The maximum light power per diode is 500 mW in case of coupling with a 1 m long glass monofiber. The pulse frequency reaches 1 MHz, and the pulse duration can be adjusted between 50 nsec and 1 microsec. The light has a wavelength of 660 nm; it is well suited for interference-optical research due to its coherence. ESA

N86-30086# Joint Publications Research Service, Arlington, Va.
JAPAN REPORT: SCIENCE AND TECHNOLOGY
21 Apr. 1986 67 p Transl. into ENGLISH from various Japanese articles
(JPRS-JST-86-011) Avail: NTIS HC A04/MF A01

Topics addressed include: biotechnology, energy, and electronics. For individual titles, see N86-30087 through N86-30087.

N86-30087# Joint Publications Research Service, Arlington, Va.
ISSUES IN LSI AUTOMATION, PROTOCOL STANDARDIZATION
Naoshi Sugiyama *In its* Japan Report: Science and Technology (JPRS-JST-86-011) 21 Apr. 1986 p 46-57 Transl. into ENGLISH from Denshi Kogyo Geppo (Tokyo, Japan), Sep. 1985 p 14-20 (For primary document see N86-30086 21-33)
Avail: NTIS HC A04/MF A01

In order to realize the complete unmanned factory, many problems such as clean robot technology, clean transfer technol-

ogy, and fault restoration countermeasures have to be solved. The present conditions of automation technology are presented and then the standardization trends of hardware and software (communication agreement protocol) essential to the construction of unmanned factories are examined. B.G.

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N86-30088 British Library Lending Div., Boston Spa (England).
HYDRODYNAMICS AND HEAT TRANSFER IN A LIQUID FILM UNDER THE END OF A ROTATING CYLINDER
V. A. Timofeev 1986 10 p Transl. into ENGLISH> from IZ. (USSR), p 40-44
(BLL-M-36755-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

The situation considered in this theoretical study is that a metallic cylinder is placed in a liquid heated to a certain temperature and is itself heated by the passage of an electric current to a certain temperature. The cylinder is rotated. Equations describing the hydrodynamics and heat transfer in the liquid metallic film formed under the end of the cylinder are derived. They show that the film thickness decreases with increasing distance from the axis of rotation. Melting is weakest in the zone near the axis of rotation and the edge of the cylinder. Author

N86-30089 Royal Netherlands Aircraft Factories Fokker, Amsterdam.
STUDY OF HEAT EXCHANGERS BETWEEN A LIQUID LOOP FEEDER AND A HEAT-PIPE RADIATOR
A. F. J. Morgownik 9 Aug. 1984 128 p Sponsored by Netherlands Agency for Aerospace Programs
(FOK-TR-R-84-108; ESA-86-97500) Copyright. Avail: Issuing Activity

Heat exchanger designs, capable of transporting 2500 W from the cooling liquid (Freon 114) to the vapor of the radiator heat pipes were developed. The thermal, flow, mass, micrometeorite vulnerability, and manufacturing performance were analyzed. A finned evaporator concept, concentric interface concept, clamped folded-interface concept, and soldered interface concept are described. Best performance predictions are obtained for the clamped interface concept. ESA

N86-30090*# Nevada Univ., Reno. Engineering Research and Development Center.
COMPUTATIONS AND TURBULENT FLOW MODELING IN SUPPORT OF HELICOPTER ROTOR TECHNOLOGY Final Report, 1 Jun. 1984 - 30 Nov. 1985
William C. Rose Nov. 1985 53 p
(Grant NsG-2291)
(NASA-CR-177095; NAS 1.26:177095) Avail: NTIS HC A04/MF A01 CSCL 20D

The angle of attack (AOA) tandem cavity wind tunnel experiment was prepared. Actual wind tunnel testing started shortly after the beginning of 1985. A multi-probe aerodynamic rake was designed and installed for use in surveying the shear layers present over the open cavity on the Kuiper Airborne Observatory (KAO). The nature of the behavior of the thermal environment within the KAO cavity at operational altitudes was determined. Assistance was given in the design of the cavity for the University of Denver radiometer. Attempts to distinguish between the optical terms of blur circle size (or image size) and the term due to jitter were discussed. B.G.

N86-30091*# Clarkson Univ., Potsdam, N.Y. Dept. of Mechanical and Industrial Engineering.
SEPARATED FLOWS NEAR THE NOSE OF A BODY OF REVOLUTION Final Project Report, 1 Jan. 1984- 28 Feb. 1986
S. P. Lin 28 Feb. 1986 89 p
(Contract NCC2-280)
(NASA-CR-177107; NAS 1.26:177107) Avail: NTIS HC A05/MF A01 CSCL 20D

The solution of the Navier-Stokes equations for the problem of cross-flow separation about a deforming cylinder was achieved by iteration. It was shown that the separation starts at the rear stagnation point and the point of primary separation moves upstram along the cylinder surface. A general method of linear stability analysis for nonparallel external flows was constructed, which consists of representing the eigenfunctions with complete orthogonal sets and forms characteristic equations with the Galerkin method. The method was applied to the Kovasznay flow which is an exact solution of the Navier-Stokes equation. The results show that when the critical parameter is exceeded, there are only a few isolated unstable eigen-frequencies. Another exact solution is shown to be absolutely and monotonically stable with respect to infinitesimal disturbances of all frequencies. The flow is also globally, asymptotically, and monotonically stable in the mean with respect o three-dimensional disturbances. This result forms the sound foundation of rigorous stability analysis for nonparallel flows, and provides an invaluable test ground for future studies of nonparallel flows in which the basic states do not posses exact solutions. The application of this method to the study of the formation of spiral vorticies near the nose of a rotating body of revolution is underway. The same method will be applied to the stability analysis of reversed flow over a plate with suction. B.G.

N86-30092*# California Univ., Davis. Dept. of Mechanical Engineering.
NUMERICAL AND EXPERIMENTAL STUDIES OF PARTICLE FLOW IN A HIGH-PRESSURE BOUNDARY-LAYER WIND TUNNEL Semiannual Progress Report, Jan. - Jun. 1984
B. R. White Jun. 1984 11 p
(Contract NCC2-252)
(NASA-CR-177008; NAS 1.26:177008) Avail: NTIS HC A02/MF A01 CSCL 20D

The approach was to simulate the surface environment of Venus as closely as practicable and to conduct experiments to determine threshold wind speeds, particle flux, particle velocities, and the characteristics of various aeolian bedforms. The Venus Wind Tunnel (VWT) is described and the experimental procedures that were developed to make the high-pressure wind tunnel measurements are presented. In terrestrial simulations of aeolian activity, it is possible to conduct experiments under pressures and temperatures found in natural environments. Because of the high pressures and temperatures, Venusian simulations are difficult to achieve in this regard. Consequently, extrapolation of results to Venue potentially involves unknown factors. The experimental rationale was developed in the following way: The VWT enables the density of the Venusian atmosphere to be reproduced. Density is the principal atmospheric property for governing saltation threshold, particle flux, and the ballistics of airborne particles (equivalent density maintains dynamic similarity of gas flow). When operated at or near Earth's ambient temperature, VWT achieves Venusian atmospheric density at pressures of about 30 bar, or about one third less than those on Venus, although still maintaining dynamic similarity to Venus. Author

N86-30093*# Dayton Univ., Ohio.
NUMERICAL SIMULATION OF THE FLOWFIELD OVER ICE ACCRETION SHAPES Semiannual Progress Report, 30 Apr. 1985 - 30 Apr.1986
James N. Scott Apr. 1986 19 p Submitted for publication
(Grant NAG3-665)
(NASA-CR-176960; NAS 1.26:176960) Avail: NTIS HC A02/MF A01 CSCL 20D

The primary goals are directed toward the development of a numerical method for computing flow about ice accretion shapes and determining the influence of these shapes on flow degradation. It is expedient to investigate various aspects of icing independently

in order to assess their contribution to the overall icing phenomena. The specific aspects to be examined include the water droplet trajectories with collection efficiencies and phase change on the surface, the flowfield about specified shapes including lift, drag, and heat transfer distribution, and surface roughness effects. The configurations computed were models of ice accretion shapes formed on a circular cylinder in the NASA Lewis Icing Research Tunnel. An existing Navier-Stokes program was modified to compute the flowfield over four shapes (2, 5, and 15 minute models of glaze ice, and a 15 minute accumulation of rime ice). B.G.

N86-30094*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EXPERIMENTAL RESULTS OF THE CONTROL OF A VORTICAL FLOW BY TANGENTIAL BLOWING
N. J. Wood and L. Roberts May 1986 73 p Sponsored by NASA
(NASA-CR-176932; NAS 1.26:176932; JIAA-TR-71) Avail: NTIS HC A04/MF A01 CSCL 20D

The results of a wind tunnel test to investigate the controlling effects of tangential, leading edge blowing on the vortical flow over a delta wing are given. Blowing is used to directly control the crossflow separation points at the rounded leading edge and hence, the trajectory of the feeding sheet and the location of the vortex. Experiments were conducted for both co-flowing and counter-flowing configurations over a range of angles of attack from 0 to 90 degrees. Results in the form of pressure distributions, overall force coefficients and flow mappings were obtained. The emphasis is on data presentation rather than detailed analysis. The initial results indicate that the co-flowing configuration was capable of extending the regime of stable, controlled vortical flow over the upper surface by approximately 30 degrees angle of attack for modest blowing requirements. Increases in maximum normal force coefficient of approximately 30% were achieved and significant rolling moments produced at angles of attack from 30 to 60 degrees. The counter-flowing configuration indicated only minor lift augmentation with the exception of an isolated occurrence at 20 degrees angle of attack. At that condition, with very weak blowing, a lift augmentation of approximately 20 was measured.
Author

N86-30095*# Polyatomics Research, Inc., Mountain View, Calif.
OPTICAL DIAGNOSTICS OF GAS-DYNAMIC FLOWS USING ADVANCED LASER MEASUREMENT TECHNIQUES Final Report, 1 Oct. 1983 - 31 Dec. 1984
Kenneth P. Gross 17 Jul. 1985 61 p
(Contract NCC2-244)
(NASA-CR-176950; NAS 1.26:176950) Avail: NTIS HC A04/MF A01 CSCL 20D

Using laser-induced fluorescence to probe nitrogen flows seeded with small amounts of nitric oxide, simultaneous measurements of all three thermodynamic scalar quantities temperature, density, and pressure, were demonstrated in a supersonic turbulent boundary layer. Instrumental uncertainty is 1% for temperature and 2% for density and pressure, making the techniques suitable for measurements of turbulent fluctuations. This technology is currently being transferred to an experimental program designed to use these optical techniques in conjunction with traditional methods to make measurements in turbulent flowfields that were not possible before. A detailed descritpion of the research progress and pertinent results are presented. B.G.

N86-30096*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONSTRUCTION OF HIGHER ORDER ACCURATE VORTEX AND PARTICLE METHODS Final Report
R. A. Nicolaides (Carnegie-Mellon Univ., Pittsburgh, Pa.) Jun. 1986 21 p Submitted for publication
(Contracts NAS1-17070; NAS1-18107; Grant AF-AFOSR-0137-84)
(NASA-CR-178132; NAS 1.26:178132; ICASE-86-42) Avail: NTIS HC A02/MF A01 CSCL 20D

The standard point vortex method has recently been shown to be of high order of accuracy for problems on the whole plane, when using a uniform initial subdivision for assigning the vorticity to the points. If obstacles are present in the flow, this high order deteriorates to first or second order. New vortex methods are introduced which are of arbitrary accuracy (under regularity assumptions) regardless of the presence of bodies and the uniformity of the initial subdivision. Author

N86-30097*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INCIPIENT TRANSITION PHENOMENA IN COMPRESSIBLE FLOWS OVER A FLAT PLATE Final Report
Gordon Erlebacher and M. Yousuff Hussaini Jun. 1986 22 p Presented at the 10th International Conference on Numerical Methods in Fluid Dynamics
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178111; NAS 1.26:178111; ICASE-86-39) Avail: NTIS HC A02/MF A01 CSCL 20D

The full three-dimensional time-dependent compressible Navier-Stokes equations are solved by a Fourier-Chebyshev method to study the stability of compressible flows over a flat plate. After the code is validated in the linear regime, it is applied to study the existence of the secondary instability mechanism in the supersonic regime. Author

N86-30098*# Old Dominion Univ., Norfolk, Va.
THERMAL SENSING OF CRYOGENIC WIND TUNNEL MODEL SURFACES Final Report, 15 May 1984 - 28 Feb. 1985
Kamran Daryabeigi and Robert L. Ash Jul. 1986 56 p
(Contract NAS1-17099)
(NASA-CR-178136; NAS 1.26:178136) Avail: NTIS HC A04/MF A01 CSCL 20D

Different sensors and installation techniques for surface temperature measurement of cryogenic wind tunnel models were investigated. Silicon diodes were selected for further consideration because of their good inherent accuracy (their average absolute temperature deviation in comparison tests with standard platinum resistance thermometers was found to be 0.2 K in the range from 125 to 273 K). Subsurface temperature measurement was selected as the installation technique in order to minimize aerodynamic interference. Temperature distortion caused by an embedded silicon diode was studied numerically. Author

N86-30099*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
MODELING OF TRANSIENT HEAT PIPE OPERATION Semiannual Status Report, 19 Aug. 1985 - 18 Feb. 1986
Gene T. Colwell and James G. Hartley Jun. 1986 32 p
(Grant NAG1-392)
(NASA-CR-177143; NAS 1.26:177143) Avail: NTIS HC A03/MF A01 CSCL 20D

Mathematical models and associated solution procedures which can be used to design heat pipe cooled structures for use on hypersonic vehicles are being developed. The models should also have the capability to predict off-design performance for a variety of operating conditions. It is expected that the resulting models can be used to predict startup behavior of liquid metal heat pipes to be used in reentry vehicles, hypersonic aircraft, and space nuclear reactors. Work to date related to numerical solutions of governing differential equations for the outer shell and the combination capillary structure and working fluid is summarized. Finite element numerical equations using both implicit, explicit, and combination methods were examined. Author

N86-30100*# Old Dominion Univ., Norfolk, Va. Research Foundation.
CONVECTIVE HEAT TRANSFER FROM CIRCULAR CYLINDERS LOCATED WITHIN PERFORATED CYLINDRICAL SHROUDS Final Report, 16 Oct. 1985 - 30 Sep. 1986
Kamran Daryabeigi and Robert L. Ash Washington NASA Aug. 1986 99 p
(Contract NAS1-17993)
(NASA-CR-4005; NAS 1.26:4005) Avail: NTIS HC A05/MF A01 CSCL 20D

The influence of perforated cylindrical shrouds on the convec-

tive heat transfer to circular cylinders in transverse flow has been studied experimentally. Geometries studied were similar to those used in industrial platinum resistance thermometers. The influence of Reynolds number, ventilation factor (ratio of the open area to the total surface area of shroud), radius ratio (ratio of shroud's inside radius to bare cylinder's radius), and shroud orientation with respect to flow were studied. The experiments showed that perforated shrouds with ventilation factors in the range 0.1 to 0.4 and radius ratios in the range 1.1 to 2.1 could enhance the convective heat transfer to bare cylinders up to 50%. The maximum enhancement occurred for a radius ratio of 1.4 and ventilation factors between 0.2 and 0.3. It was found that shroud orientation influenced the heat transfer, with maximum heat transfer generally occurring when the shroud's holes were centered on either side of the stagnation line. However, the hole orientation effect is of second order compared to the influence of ventilation factor and radius ratio. Author

N86-30101*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE ADVANTAGES OF THE VORTICITY-VELOCITY FORMULATION OF THE EQUATIONS OF FLUID DYNAMICS Final Report
Charles G. Speziale May 1986 11 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178125; NAS 1.26:178125; ICASE-86-35) Avail: NTIS HC A02/MF A01 CSCL 20D

The mathematical properties of the pressure-velocity and vorticity-velocity formulations of the equations of viscous flow are compared. It is shown that a vorticity-velocity formulation exists which has the interesting property that non-inertial effects only enter the problem through the implementation of initial and boundary conditions. This valuable characteristic, along with other advantages of the vorticity-velocity approach, are discussed in detail. Author

N86-30102# Borg-Luther Group, Atascadero, Calif.
MAGNUS EFFECT: AN OVERVIEW OF ITS PAST AND FUTURE PRACTICAL APPLICATIONS, 1850-1985, VOLUMES 1 AND 2
John Borg 1986 197 p
(Contract N00024-83-C-5350; s03-98)
(AD-A165902; AD-E750983) Avail: NTIS HC A09/MF A01 CSCL 20/4

The report is in two volumes and is intended to present the known data and past and future applications of Magnus effect devices. (Magnus effect devices are very high lift devices which can be used in applications where airfoils are currently used.) This first volume includes the history of Magnus effect devices, theory and principles, a significant patent review, practical marine applications, formulas and experimental data, comparisons of Magnus effect and other state-of-the-art devices, identification of further testing needed, and a proposed test program. Appendices include rudder research and a literature critique. The second volume is a collection of the drawings for 39 magnus effect patents plus a critique of each patent evaluating its potential, especially for marine applications. Author (GRA)

N86-30103# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL OBSERVATION OF THE STRUCTURE OF SHOCK WAVES IN DUSTY GAS
Hongru Yu, Jianmin Lin, Shengxue Yuan, and Zhongfa Li 27 Mar. 1986 16 p Transl. into ENGLISH from Lixue Xuebao (China), no. 6, 1983 p 531-537
(AD-A166301; FTD-ID(RS)T-1262-85) Avail: NTIS HC A02/MF A01 CSCL 20/4

The structure of shock waves in dusty gas was studied by shock tube experiments. Pressure, shock wave velocity and dust concentration were measured under the condition that the dusty loading ratio was less than 0.4 and the shock Mach number was less than 1.5. The frozen and equilibrium pressures behind the shock wave can be well described by the Rankine Hugoniot relation. But the relaxation length was significantly shorter than that calculated from the drag of a sphere at steady motion. And the disperse shock waves in dusty gas were observed. It was found that the presence of dust decreases the pressure fluctuation in the flow. The propagation velocity of the shock wave agrees with the result of the model analysis on an effective gas. GRA

N86-30104# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
BLASTING AND BLAST EFFECTS IN COLD REGIONS. PART 1: AIR BLAST
Malcolm Mellor Dec. 1985 68 p
(AD-A166315; CRREL-SP-85-25-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 19/4

Numerous topics relative to blasting and blast effects in cold regions are discussed. Ideal blast waves in free air; the shock equations for air blast; scaling procedures for comparison of explosions; reflection and refraction of airblast; effect of charge height, or height of burst; attenuation of air blast and variation of shock front properties; Air blast from nuclear explosions; air blast from underground explosions; air blast from underwater explosions; air blast damage criteria; effects of ambient pressure and temperature; explosions in vacuum or in space; air blast attenuation over snow surfaces; shock reflection from snow surfaces; shock velocity over snow; variation of shock pressure with charge height over snow; and release of avalanches by air blast are among the topics discussed. GRA

N86-30105# Ballistic Research Labs., Aberdeen Proving Ground, Md.
TRANSIENT HEAT CONDUCTION IN SEMI-INFINITE SOLIDS WITH TEMPERATURE DEPENDENT PROPERTIES
Lang-Mann Chang Mar. 1986 40 p
(AD-A166613; BRL-TR-2720) Avail: NTIS HC A03/MF A01 CSCL 20/3

Similarity solutions are obtained for the transient heat conduction in a semi-infinite solid with temperature-dependent thermal properties. The surface of the solid is considered subjected to a time-varying boundary condition, either heat flux Q sub w = a t to the bth power or temperature T sub w = t sub 0(1 + t to the bth power). Solutions for the temperature distribution and the local heat flux are presented. In particular, type 420 stainless steel, whose thermal properties are strong functions of temperature, was chosen for analysis to demonstrate the significance of the effect of the temperature dependence of thermal properties on heat transfer calculations. GRA

N86-30106# Sandia National Labs., Albuquerque, N. Mex.
TWO-DIMENSIONAL FLUX-CORRECTED TRANSPORT SOLVER FOR CONVECTIVELY DOMINATED FLOWS
M. R. Baer and R. J. Gross Jan. 1986 78 p
(Contract DE-AC04-76DP-00789)
(DE86-005329; SAND-85-0613) Avail: NTIS HC A05/MF A01

A numerical technique designed to solve a wide class of convectively dominated flow problems is presented. An attractive feature of the technique is its ability to resolve the behavior of field quantities possessing large gradients and/or shocks. The method is a finite-difference technique known as flux-corrected transport (FCT) that maintains four important numerical considerations - stability, accuracy, monotonicity, and conservation. The theory and methodology of two-dimensional FCT is presented. The method is applied in demonstrative example calculations of a 2-D Riemann problem with known exact solutions and to the Euler equations in a study of classical Rayleigh-Taylor and Kelvin-Helmholtz instability problems. The FCT solver has been vectorized for execution on the Cray 1S - a typical call with a 50 by 50 mesh requires about 0.00428 cpu seconds of execution time per call to the routine. Additionally, we have maintained a modular structure for the solver that eases its implementation. Fortran listings of two versions of the 2-D FCT solvers are appended with a driver main progra m illustrating the call sequence for the modules. DOE

N86-30107# Los Alamos National Lab., N. Mex.
LYAPUNOV STABILITY OF IDEAL COMPRESSIBLE AND INCOMPRESSIBLE FLUID EQUILIBRIA IN THREE DIMENSIONS
D. D. Holm Aug. 1985 78 p Presented at the Fluidized Bed Combustion (FBC) Materials Workshop, Nova Scotia, Canada, 29 Jul. 1985
(Contract W-7405-eng-36)
(DE86-003648; LA-UR-85-4140; CONF-8507103-2) Avail: NTIS HC A02/MF A01

Linearized stability of ideal compressible and incompressible fluid equilibria in three dimensions is analyzed using Lyapunov's direct method. An action principle is given for the Eulerian and Lagrangian fluid descriptions and the family of constants of motion due to symmetry under fluid-particle relabelling is derived in the form of Ertel's theorem for each description. In an augmented Eulerian description, the steady equilibrium flows of these two fluids theories are identified as critical points of the conserved Lyapunov functionals defined by the sum, H + C, of the energy H, and the Ertel constants of motion, C. It turns out that unconditional linear Lyapunov stability of these flows in the norm provided by the second variation of H + C is precluded by vortex-particle stretching, even for otherwise shear-stable flows. Conditional Lyapunov stability of these flows is discussed. DOE

N86-30108# Rio Grande do Sul Univ., Porto Alegre (Brazil). Escola de Engenharia.
NAVIER-STOKES EQUATIONS BY THE FINITE ELEMENT METHOD M.S. Thesis
P. E. Portella 1984 100 p In PORTUGUESE
(DE86-700661; INIS-BR-389) Avail: NTIS (US Sales Only) HC A05/MF A01

A computer program to solve the Navier-Stokes equations by using the Finite Element Method is implemented. The solution variables investigated are stream-function/vorticity in the steady case and velocity/pressure in the steady state and transient cases. For steady state flow the equations are solved simultaneously by the Newton-Raphson method. For the time dependent formulation, a fractional step method is employed to discretize in time and artificial viscosity is used to preclude spurious oscilations in the solution. The element used is the three node triangle. Some numerical examples are presented and comparisons are made with applications already existent. DOE

N86-30109# Laboratorio de Computacao Cientifica, Rio de Janeiro (Brazil).
FINITE-ELEMENT MODEL IN VORTICITY AND CURRENT FUNCTION FOR THE NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS
F. daCunhaFurtado and A. C. N. R. Galeao 1984 22 p In PORTUGUESE Presented at the 5th Latin-American Congress on Computational Methods for Engineering, Salvador, Brazil, 1 Oct. 1984
(DE86-700787; LCC-027/84; CONF-8410361-1) Avail: NTIS (US Sales Only) HC A02/MF A01

A numerical procedure for the integration of the incompressible Navier-Stokes equations, when expressed in terms of a stream function equation and a vorticity transport equation, is presented. This procedure comprises the variational formulation of the equations, the construction of the approximation spaces by the finite element method and the discretization via the Galerkin method. For the stationary problems, the system of non-linear algebraic equations resulting from the discretization is solved by the Newton-Raphson algorithm. Finally, for the transient problems, the solution of the non-linear ordinary differential equations resulting from the spatial discretization is accomplished through a Crank-Nicolson scheme. DOE

N86-30110# KMS Fusion, Inc., Ann Arbor, Mich.
OBSERVATIONS OF MASS TRANSPORT PHENOMENA IN MULTICOMPONENT LIQUID MIXTURES
M. T. Mruzek, D. L. Musinski, and R. B. Jacobs 1985 8 p Presented at the 32nd National Vacuum Symposium and Topical Conference, Houston, Tex., 19 Nov. 1985
(Contract DE-AC08-82DP-40152)
(DE86-006483; KMSF-U-1678e; CONF-851174-31) Avail: NTIS HC A02/MF A01

Examples of surface tension effects on liquid behavior are common, such as liquid rising in a capillary tube or the beading of rain drops on a freshly waxed car. Usually though, the surface tension forces are small compared to other forces such as gravity. Situations exist, however, where the simple statement attributed to Marangoni can explain striking and unexpected observations. If for any reason difference of surface tension exists along a free liquid surface, liquid will flow toward the region of higher surface tension. Such flows are called Marangoni flows. Observations of isotopic hydrogen fuel mixtures in cryogenic Inertial Confinement Fusion targets can be explained on the basis of Marangoni flows. Additional experiments at KMS with common room temperature mixtures have produced similar results. DOE

N86-30111# Sandia National Labs., Albuquerque, N. Mex.
EVIDENCE OF NONUNIQUENESS AND OSCILLATORY SOLUTIONS IN COMPUTATIONAL FLUID MECHANICS
J. W. Nunziato, D. K. Gartling, and M. E. Kipp 1985 55 p Presented at the Workshop on Oscillation Theory Computation and Methods of Compensated Compactness, Minneapolis, Minn., 1 Apr. 1985
(Contract DE-AC04-76DP-00789)
(DE86-006493; SAND-85-0861C; CONF-8504203-1) Avail: NTIS HC A04/MF A01

We will review some of our recent experiences in computing solutions for nonlinear fluids in relatively simple, two-dimensional geometries. The purpose of this discussion will be to display by example some of the interesting but difficult questions that arise when ill-behaved solutions are obtained numerically. We will consider two examples. As the first example, we will consider a nonlinear elastic (compressible) fluid with chemical reactions and discuss solutions for detonation and detonation failure in a two-dimesnisonal cylinder. In this case, the numerical algorithm utilizes a finite-difference method with artifical viscosity (von Neuman-Richtmyer method) and leads to two, distinctly different, stable solutions depending on the time step criterion used. The second example to be considered involves the convection of a viscous fluid in a rectangular container as a result of an exothermic polymerization reaction. A solidification front develops near the top of the container and propagates down through the fluid, changing the aspect ratio of the region ahead of the front. Using a Galerkin-based finite element method, a numerical solution of the partial differential equations is obtained which tracks the front and correctly predicts the fluid temperatures near the walls. However, the solution also exhibits oscillatory behavior with regard to the number of cells in the fluid ahead of the front and in the strength of the cell. More definitive experiments and analysis are required to determine whether this oscillatory phenomena is a numerical artifact or a physical reality. DOE

N86-30112# Minnesota Univ., Minneapolis.
INTERNATIONAL WORKSHOP ON TWO-PHASE FLOW FUNDAMENTALS
Joseph Kestin and Michael Z. Powdowski, ed. Jan. 1986 104 p Workshop held in Gaithersburg, Md., 22-27 Sep. 1985 Prepared in cooperation with NBS, Gaithersburg, Md.
(Contract DE-AC02-83ER-13056)
(DE86-006548; DOE/ER-13056/1) Avail: NTIS HC A06/MF A01

This document contains a report of the International Workshop on Two-Phase Flow Fundamentals. It includes summaries of the workshop discussions and recommendations of the Workshop Evaluation Committee. The primary objective of the workshop was to identify, formulate and prioritize research problems in the field of multiphase flow and heat transfer which are important for the development of efficient energy systems. In addition, contributions were made to the development of multiphase science by creating a basis for the systematic comparison between mathematical models and experiments. DOE

N86-30113# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
PRESSURE DROP IN FLASHING FLOW THROUGH OBSTRUCTIONS
M. E. Weinle and B. S. Johnston 19 Dec. 1985 19 p
(Contract DE-AC09-76SR-00001)
(DE86-007152; DPST-85-964) Avail: NTIS HC A02/MF A01

An experiment was designed to investigate the pressure drop for flashing flow across obstructions of different geometries at various flow rates. Tests were run using two different orifices to determine if the two-phase pressure drop could be characterized by the single phase loss coefficient and the general behavior of the two-phase multiplier. For the geometries studied, it was possible to correlate the multiplier in a geometry-independent fashion. DOE

N86-30114# Argonne National Lab., Ill.
STRUCTURAL DYNAMICS AND FLUID FLOW IN SHELL-AND-TUBE HEAT EXCHANGERS. SUMMARY AND OVERVIEW OF A DOE/ECUT-SPONSORED RESEARCH PROGRAM
M. W. Wambsganss, H. Halle, and T. M. Mulcahy Dec. 1985 79 p
(Contract W-31-109-eng-38)
(DE86-007798; ANL-85-76) Avail: NTIS HC A05/MF A01

Objective of the research program is to contribute to the design and development of energy-efficient, reliable, and cost-competitive industrial shell-and-tube heat exchangers. This report highlights the many technical contributions of the DOE/ECUT-sponsored program, reviews industry's use of the program results, and identifies research needs. Vibration excitation mechanisms, fluid/structure coupling, and flow distribution are briefly reviewed to provide background information. To date, the program has focused on the development of data bases of tube vibration and pressure drop information, derived from tests of a specially designed industrial-size heat exchanger. The development of an improved prediction method for fluid-elastic instability thresholds and the numerical simulation and measurement of flow distribution have also been addressed. Gas and two-phase flow testing is among the future research needs identified; such testing would require substantial modifications to the existing Heat Exchanger Test Facility. Industrial support, leading to a DOE/industry co-sponsored research pr ogram, is sought to allow for required modifications to the test facility, subsequent gas and two-phase flow testing, and expansion of the program to include further development of vibration and flow distribution prediction methods and related research. DOE

N86-30115# Technical Research Centre of Finland, Espoo.
INFLUENCE OF CONDITIONS ON THE PERFORMANCE OF SMALL HEAT PUMPS
R. Wiksten Sep. 1985 29 p In FINNISH
(DE86-751178; VTT-TUTK-366) Avail: NTIS (US Sales Only) HC A03/MF A01

In the report the use of laboratory measurement results of small heat pumps are examined when the conditions differ from those in the laboratory. First, the influences of different conditions on the continuous operation are examined. The investigation is both theoretical and empirical. According to the measurements, changes in the fluid flow to the evaporator do not influence the coefficient of performance but they do influence the heating power from the condensator. The annual coefficient of performance is also calculated, based on measurement results from laboratory. The annual coefficient of performance is calculated for a ground heat pump and for an air-to-air heat pump. The annual coefficient of performance for an air-to-air heat pump cannot be calculated by taking the coefficient of performance at average outdoor temperature. It can be calculated with the aid of the heat demand for the building and the corresponding outdoor temperature and the energy flows of the heat pump measured in stationary conditions. There is then no need for a dynamical coefficient of performance. DOE

N86-30116# Los Alamos National Lab., N. Mex.
NASA-VOF2D: A COMPUTER PROGRAM FOR INCOMPRESSIBLE FLOWS WITH FREE SURFACES
M. D. Torrey, L. D. Cloutman, R. C. Mjolsness, and C. W. Hirt Dec. 1985 138 p
(Contract W-7405-eng-36)
(DE86-007195; LA-10612-MS) Avail: NTIS HC A07/MF A01

We present the NASA-VOF2D two-dimensional, transient, free-surface hydrodynamics program. It has a variety of options that provide capabilities for a wide range of applications, and it is designed to be relatively easy to use. It is based on the fractional volume-of-fluid method, and allows multiple free surfaces with surface tension and wall adhesion. It also has a partial cell treatment that allows curved boundaries and internal obstacles. This report includes a discussion of the numerical method, a code listing, and a selection of sample problems. DOE

N86-30117# Oak Ridge National Lab., Tenn.
NEW AND FUTURE HEAT PUMP TECHNOLOGIES
F. A. Creswick 1986 11 p Presented at the Meeting Customer Needs With Heat Pumps Seminar and Exposition, Kansas City, Mo., 8 Apr. 1886
(Contract DE-AC05-84OR-21400)
(DE86-007866; CONF-860477-1) Avail: NTIS HC A02/MF A01

It is not possible to say for sure what future heat pumps will look like, but there are some interesting possibilities. In the next five years, we are likely to see US heat pumps with two kinds of innovations: capacity modulation and charge control. Capacity modulation will be accomplished by variable-speed compressor motors. The objective of charge control is to keep the refrigerant charge in the system where it belongs for best performance; there are probably many ways to accomplish this. Charge control will improve efficiency and durability; capacity modulation will further improve efficiency and comfort. The Stirling cycle heat pump has several interesting advantages, but it is farther out in time. At present, we don't know how to make it as efficient as the conventional vapor-compression heat pump. Electric utility people should be aware that major advances are being made in gas-fired heat pumps which could provide strong competition in the future. However, even a gas-fired heat pump has a substantial auxiliary electric power requirement. The resources needed to develop advanced heat pumps are substantial and foreign competition will be intense. It will be important for utilities, manufacturers, and the federal government to work in close cooperation. DOE

N86-30118# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
COMPUTATION OF DENSE SPRAY JETS
A. U. Chatwani and F. V. Bracco 1985 12 p Presented at the 3rd International Conference on Liquid Atomisation and Spray Systems, London, England, 8 Jul. 1985
(Contract DE-AC04-81AL-16338)
(DE86-008176; CONF-850796-1) Avail: NTIS HC A02/MF A01

A dense-spray model, that already accounted for drop collisions and coalescence and the influence of liquid volume-fraction on the exchange rates of mass, momentum, and energy between gas and drops, is here extended, using a line source technique, to account also for the intact liquid core in full-cone sprays from jet atomizers. The intact core significantly modifies the computed structure of the near field. The far field is found again not to be sensitive to the near field events and representation and the computed far field drop velocities are shown to compare favorably with measurements. DOE

N86-30119# Oak Ridge National Lab., Tenn.
MODELING OF FLOW FIELDS IN OSCILLATING DROPLETS
T. C. Scott 1986 28 p Presented at the 1st International Conference on Separations Science and Technology, New York, N.Y., 16 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-008232; CONF-860411-2) Avail: NTIS HC A03/MF A01

Quantitative and qualitative flow visualization techniques have been used to model flow fields which occur in the droplet-continuum system for liquid-liquid solvent extraction. It was determined that the streamlines for flow in and around oscillating droplets can be modeled as the vectorial addition of low Reynolds number

Hadamard flow and flow caused by an oscillating Dirichlet ellipsoid. DOE

N86-30120# Los Alamos National Lab., N. Mex.
CAVEAT: A COMPUTER CODE FOR FLUID DYNAMICS PROBLEMS WITH LARGE DISTORTION AND INTERNAL SLIP
F. L. Addessio, D. E. Carroll, J. K. Dukowicz, F. H. Harlow, J. N. Johnson, B. A. Kashiwa, M. E. Maltrud, and H. M. Ruppel Feb. 1986 223 p
(Contract W-7405-eng-36)
(DE86-008570; LA-10613-MS) Avail: NTIS HC A10/MF A01

This report describes the CAVEAT computer code, which numerically solves the equations of transient, multimaterial, compressible fluid dynamics. General material equations of state are allowed by the use of the SESAME library. Of particular interest is the general capability to handle material interfaces, including slip, cavitation, or void closure. Also included is the capability to treat material strength and plasticity, high explosive (HE) detonations, and a k-epsilon model of turbulence. DOE

N86-30121# Metraflu, Ecully (France).
SPECTRAL STUDY OF TURBULENCE. PURE ROTATION AND INTRODUCTION TO MODE COMPOSITION Final Report [ETUDE SPECTRALE DE LA TURBULENCE. ROTATION PURE ET INTRODUCTION A LA DECOMPOSITION MODALE]
C. Cambon, C. Teissedre, and D. Jeandel Feb. 1985 64 p In FRENCH
(Contracts DRET-83-225; DRET-83-34-225-00-470-75-01)
(ESA-86-97273) Avail: NTIS HC A04/MF A01

A theoretical and simulation study of turbulence is presented. A three dimensional spectral description in a Fourier space is adopted. The nonlinear interactions are studied using a computerized simulation of a three dimensional anisotropic configuration which is too expensive for aeronautical use but useful for model validation. A simplified configuration taking into account Coriolis force in the evolution of triple correlations predicts an anisotropic evolution of the double correlations and a reduction of the energy transfer due to rotation effects. A small number of modes is found for a large number of anisotropic flows even in the case of large evolution times. ESA

N86-30122# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Energetique.
MODELS AND PREDICTION OF TURBULENT FLOW WITH SUSPENDED PARTICLES Interim Report [ETUDE SUR LA MODELISATION ET LA PREDICTION D'ECOULEMENTS TURBULENTS AVEC PARTICULES (RAPPORT INTERMEDIAIRE)]
A. Berlemont, P. Desjonqueres, G. Gouesbet, and B. Julien 17 Dec. 1985 53 p In FRENCH
(Contract DRET-84-34-001)
(ONERA-RT-22/7135-EY; ESA-86-97278) Avail: NTIS HC A04/MF A01

The validity of the Stokes term contained in the Tchen equation and the overall validity of the Tchen equation are examined. A criterion to decide wether the Stokes term is sufficient is described. It takes in account turbulent quantities such as the velocity fluctuations. A computer program was prepared. The rotation of particles in a turbulent flow was studied. This is related to the Arnason experimental results indicating the easier dispersion of larger particles. Preliminary computation shows that the additional contributions of two lift forces could explain Arnason's results. These are a lift related to particle angular velocity and a second lift characteristic of shear flow. ESA

N86-30123# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Energetique.
MODELS AND PREDICTION OF TURBULENT FLOW WITH SUSPENDED PARTICLES. REPORT ON THE WORK DONE BY ROUEN UNIVERSITY IN 1984-85 [ETUDE SUR LA MODELISATION ET LA PREDICTION D'ECOULEMENTS TURBULENTS AVEC PARTICULES. SYNTHESE DES TRAVAUX 84-85 DE L'UNIVERSITE DE ROUEN]
A. Berlemont, P. Desjonqueres, G. Gouesbet, and B. Julien 17 Dec. 1985 69 p In FRENCH
(Contract DRET-84-34-001)
(ONERA-RT-23/7135-EY; ESA-86-97279) Avail: NTIS HC A04/MF A01

The validity of the Stokes term contained in the Tchen equation and the overall validity of the Tchen equation are examined. Criteria are found to decide whether the Stokes contribution is sufficient to describe the main term of the movement of a particle in a turbulent flow. For the overall analysis it is noticed that some forces are not included in the Tchen equation and that the Arnason experimental results indicating the easier dispersion of larger particles should be explained. A Lagrangian approach is adopted and the Scope computer program was developed. Results show that an exponential Lagrangian correlation is not good enough. A correlation using Frenkiel functions is being explored. ESA

N86-29824# Arizona State Univ., Tempe. Dept. of Mechanical and Aerospace Engineering.
COOLING TECHNIQUES FOR GAS TURBINE AIRFOILS: A SURVEY
Darryl E. Metzger *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29825# Rolls-Royce Ltd., Bristol (England). Turbine Research and Methods.
ROTATING HEAT TRANSFER INVESTIGATIONS ON A MULTI-PASS COOLING GEOMETRY
R. J. Clifford *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29826# Hull Univ. (England). Dept. of Engineering Design and Manufacture.
LOCAL AND MEAN HEAT TRANSFER ON THE LEADING AND TRAILING SURFACES OF A SQUARE-SECTIONED DUCT ROTATING IN THE ORTHOGONAL-MODE
W. D. Morris and S. P. Harasgama (Royal Aircraft Establishment, Farnborough (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29827# Pratt and Whitney Aircraft of Canada Ltd., Longueuil (Quebec).
PRESSURE DROP AND HEAT TRANSFER CHARACTERISTICS OF CIRCULAR AND OBLONG LOW ASPECT RATIO PIN FINS
S. C. Arora and W. Abdel Messeh *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 15 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29828# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
EXTERNAL HEAT TRANSFER STUDY ON A HP TURBINE ROTOR BLADE
T. Arts and C. G. Graham (Rolls-Royce Ltd., Bristol (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29829# Karlsruhe Univ. (West Germany). Lehrstuhl und Inst. fuer Thermische Stroemungsmach
EFFECTS OF WAKES ON THE HEAT TRANSFER IN GAS TURBINE CASCADES
S. Wittig, A. Schulz, H. J. Bauer, and K. H. Sill *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29830# Oxford Univ. (England). Dept. of Engineering Science.
WAKE-PASSING IN A TURBINE ROTOR CASCADE

D. J. Doorly, M. L. G. Oldfield, and C. T. J. Scrivener (Rolls-Royce Ltd., Derby, England) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 18 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29831# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
EFFECTS OF HOLE GEOMETRY, WALL CURVATURE AND PRESSURE GRADIENT ON FILM COOLING DOWNSTREAM OF A SINGLE ROW
H. Kruse *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29832# Sussex Univ., Brighton (England).
EFFECTS OF SURFACE ROUGHNESS ON HEAT TRANSFER TO GAS TURBINE BLADES
A. B. Turner, F. H. A. Tarada, and F. J. Bayley *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 10 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29833# Oxford Univ. (England). Dept. of Engineering Science.
THE EFFECT OF DENSITY RATIO ON THE FILM-COOLING OF A FLAT PLATE
C. J. P. Forth, P. J. Loftus, and T. V. Jones *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29834# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France). Etudes Generales Aerothermiques.
STUDIES OF HEAT TRANSFER ON THE BASE OF TURBINE NOZZLES WITH AND WITHOUT FILM COOLING [ETUDES DES TRANSFERTS THERMIQUES SUR LES PLATES-FORMES DE DISTRIBUTEUR DE TURBINE AVEC ET SANS FILM DE REFROIDISSEMENT]
Ann-Elisabeth Bouiguignon *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 9 p In FRENCH (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29835# Rolls-Royce Ltd., Derby (England). Mechanical Technology.
SHROUD SEGMENTS FOR UNSHROUDED BLADE TURBINES
R. S. Attwood *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29836# Brown, Boveri und Cie, A.G., Baden (Switzerland).
ENGINE TESTS ON A COOLED GAS TURBINE STAGE
H. J. Graf *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 16 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29837# Westinghouse Canada, Inc., Hamilton (Ontario).
HEAT TRANSFER TEST EVALUATION OF THE SHELL-SPAR BLADE COOLING CONCEPT APPLIED TO INDUSTRIAL GAS TURBINES
G. P. Butt and W. Edward North (Westinghouse Electric Corp., Concordville, Pa.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 17 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29838# Calspan Advanced Technology Center, Buffalo, N.Y. Physical Sciences Dept.
HEAT-FLUX MEASUREMENTS AND ANALYSIS FOR A ROTATING TURBINE STAGE
Michael G. Dunn *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29839# Karlsruhe Univ. (West Germany). Inst. fuer Hydromechanik.
CALCULATION OF LAMINAR-TURBULENT BOUNDARY LAYER TRANSITION ON TURBINE BLADES
W. Rodi and G. Scheuerer (Erlangen-Nuremberg Univ. (West Germany).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29840# Purdue Univ., West Lafayette, Ind. School of Mechanical Engineering.
A MODEL FOR CORRELATING FLAT PLATE FILM COOLING EFFECTIVENESS FOR ROWS OF ROUND HOLES
M. R. LEcuyer and F. O. Soechting (Pratt and Whitney Aircraft, West Palm Beach, Fla.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29841# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
COMPUTATION OF THERMAL RADIATION FOR GAS TURBINE CONDITIONS
M. G. Carvalho, D. F. G. Durao, and F. C. Lockwood (Imperial Coll. of Science and Technology, London (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 7 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29842# Sussex Univ., Brighton (England). Thermo-Fluid Mechanics Research Centre.
PREDICTION OF TRANSIENT TEMPERATURES FOR AN AIR-COOLED ROTATING DISC
C. A. Long and J. M. Owen *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29843# Norges Tekniske Hoegskole, Trondheim. Dept. of Engineering Thermodynamics.
HEAT TRANSFER IN GAS TURBINE COMBUSTORS: A DISCUSSION OF MATHEMATICAL MODELING OF COMBUSTION, HEAT AND MASS TRANSFER WITH EMPHASIS ON HEAT TRANSFER IN GAS TURBINE COMBUSTORS
Bjorn F. Magnussen *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 17 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29844# Trent Polytechnic, Nottingham (England). Dept. of Mechanical Engineering.
EFFECTIVENESS MEASUREMENTS FOR A COOLING FILM DISRUPTED BY A SINGLE JET WITH WALL PLUNGING
B. L. Button *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 10 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29845# Detroit Diesel Allison, Indianapolis, Ind.
ALTERNATE COOLING CONFIGURATIONS FOR GAS TURBINE COMBUSTION SYSTEMS
D. A. Nealy, S. B. Reider, and H. C. Mongia *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 15 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29846# Leeds Univ. (England). Dept. of Fuel and Energy.
FULL COVERAGE IMPINGEMENT HEAT TRANSFER: THE VARIATION IN PITCH TO DIAMETER RATIO AT A CONSTANT GAPP

G. E. Andrews, A. A. Asere, C. I. Hussain, and M. C. Mkpadi *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 13 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29847# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France). Centre de Villaroche
COOLING TECHNIQUES FOR TURBOJET PRE-HEATER CHANNELS [TECHNIQUES DE FROIDISSEMENT DES CANAUX DE RECHAUFFE DES TURBOREACTEURS]
M. Desaulty, P. Troullot, and S. Coutor *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 11 p In FRENCH (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29848# Oxford Univ. (England). Dept. of Engineering Science.
THE MEASUREMENT OF LOCAL HEAT TRANSFER COEFFICIENTS IN BLADE COOLING GEOMETRIES
P. T. Ireland and T. V. Jones *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 8 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29849# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AN OPTICAL PYROMETER TO MEASURE TURBINE BLADE SURFACE TEMPERATURE
Marc Charpenel and Jean Wilhem *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 10 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29850# Massachusetts Inst. of Tech., Cambridge.
HIGH FREQUENCY RESPONSE HEAT FLUX GAUGE FOR METAL BLADING
A. H. Epstein, G. R. Guenette, R. J. G. Norton (Rolls-Royce, Inc., Atlanta, Ga.), and Cao Yuzhang (Beijing Inst. of Aeronautics and Astronautics (China).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 16 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29851# Royal Aircraft Establishment, Farnborough (England). Propulsion Dept.
THE ISENTROPIC LIGHT PISTON ANNULAR CASCADE FACILITY AT RAE PYESTOCK
A. J. Brooks, D. E. Colbourne, E. T. Wedlake, T. V Jones (Oxford Univ. (England).), M. L. G. Oldfield, D. L. Schultz, and P. J. Loftus (Maryland Univ., College Park.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 23 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29852# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
MEASUREMENTS OF FLUCTUATING GAS TEMPERATURES USING COMPENSATED FINE WIRE THERMOCOUPLES
M. N. R. Nina and G. P. Pita *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 10 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29853# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
TWO SPOT LASER VELOCIMETER MEASUREMENTS OF VELOCITY AND TURBULENCE INTENSITY IN SHOCK TUBE DRIVEN TURBINE FLOWS
Richard B. Rivir, William C. Elrod (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.), and Michael G. Dunn (Calspan Advanced Technology Center, Buffalo, N.Y.) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29856# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
TRANSIENT THERMAL BEHAVIOUR OF A COMPRESSOR ROTOR WITH VENTILATION: TEST RESULTS UNDER SIMULATED ENGINE CONDITIONS
E. Reile, U. Radons, and D. K. Hennecke *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 9 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29857# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
HEAT EXCHANGERS IN REGENERATIVE GAS TURBINE CYCLES
M. N. R. Nina and M. P. N. Aguas *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 8 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29859# Technische Univ., Aachen (West Germany). Inst. for Jet Propulsion and Turbomachinery.
EFFECT OF FILM COOLING ON THE AERODYNAMIC PERFORMANCE OF A TURBINE CASCADE
O. Koellen and W. Koschel *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 16 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29861# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
AERODYNAMIC EFFECT OF COOLANT EJECTION IN THE REAR PART OF TRANSONIC ROTOR BLADES
F. H. Kost and A. T. Holmes (Rolls-Royce Ltd., Bristol, England) *In* AGARD Heat transfer and Cooling in Gas Turbines Sep. 1985 12 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29862# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. for Design Aerodynamics.
THE BOUNDARY LAYER BEHAVIOUR OF AN ADVANCED GAS TURBINE ROTOR BLADE UNDER THE INFLUENCE OF SIMULATED FILM COOLING
R. Kiock, H. Hoheisel, H. J. Dietrichs (Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).), and A. T. Holmes (Rolls-Royce Ltd., Bristol (England).) *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 19 p (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N86-30124*# Princeton Univ. Observatory, N. J.
EVALUATION OF SELECTED DETECTOR ARRAYS FOR SPACE APPLICATIONS Final Report, 1 Jun. 1982 - 30 Jun. 1985
John L. Lowrance Jun. 1985 31 p
(Grant NAG5-241)
(NASA-CR-176979; NAS 1.26:176979) Avail: NTIS HC A03/MF A01 CSCL 14B

The development of a high density Schottky barrier Infrared Charged Coupled Device (IRCCD) type image sensor for earth observation was initiated. A dual band 512 pixel linear array was developed, which was capable of being butted end to end to make an arbitrarily long linear array. Measurement made on palladium silicide IRCCDs that were two-dimensional 63 x 32 pixel arrays were summarized. The test data on a 512 pixel linear array is also summarized. B.G.

N86-30125*# Rockwell International Corp., Canoga Park, Calif.
NON-INTRUSIVE SPEED SENSOR
L. Wyett Apr. 1986 47 p
(Contract NAS8-34658)
(NASA-CR-178873; NAS 1.26:178873; RI/RD-85-283) Avail: NTIS HC A03/MF A01 CSCL 14B

In Phase I of the Non-Intrusive Speed Sensor program, a computerized literature search was performed to identify candidate technologies for remote, non-intrusive speed sensing applications in Space Shuttle Main Engine (SSME) turbopumps. The three most promising technologies were subjected to experimental evaluation to quantify their performance characteristics under the harsh environmental requirements within the turbopumps. Although the infrared and microwave approaches demonstrated excellent cavitation immunity in laboratory tests, the variable-source magnetic speed sensor emerged as the most viable approach. Preliminary design of this speed sensor encountered no technical obstacles and resulted in viable and feasible speed nut, sensor housing, and sensor coil designs. Phase II of this program developed the variable-source magnetic speed sensor through the detailed design task and guided the design into breadboard fabrication. The speed sensor and its integral speed nut were evaluated at both unit and system level testing. The final room-temperature and cryogenic spin testing of the hardware demonstrated that the sensor was capable of generating sufficient output signal to enable remote speed sensing from 1500 to 40000 rpm over a speed nut/sensor separation of 3.5 inches. Author

N86-30126# Defense Mapping Agency, Washington, D.C.
POTENTIALS OF LARGE FORMAT CAMERA PHOTOGRAPHY Final Report
R. C. Malhotra 7 Mar. 1986 33 p
(AD-A166079) Avail: NTIS HC A03/MF A01 CSCL 14/5

From the viewpoint of improved precision, resolution, area coverage, and other terrain mapping considerations, a large format camera of 30-cm focal length and a pair of stellar cameras to determine camera attitude were recommended for Apollo Missions. In this paper, the potentials of a Large Format Camera (LFC) photography are explored specifically for the purpose of carrying out photogrammetic control extension. This study is based on the error propagation analysis is in photogrammetric triangulation of a block of 22 LFC frames, having and approximate scale of 1:755,000 and taken during the October '84 Shuttle Mission 41-G. The results of the study are shown graphically as error curves of each of the simulated systems. The best results are achievable when the Geodetic Positioning System (GPS), along with minimum ground control, is used in the LFC photography block triangulation. The stellar camera is also useful in conjunction with the Geodetic Positioning System, in areas where the ground control is not available for use in the block triangulation. Average standard deviation of determination of coordinates of triangulated ground points can be as good as + or - 2.7 meters + or - 3.5 micrometers (planimetry) and + or - 5.4 meters (elevation). These correspond to + or - 3.5 micrometers (planimetry) and ; or - 7.2 micrometers (elevation) at the photo scale. GRA

N86-30127# Royal Signals and Radar Establishment, Malvern (England).
THE MELLIN TRANSFORM FILTER: A COMPUTER GENERATED HOLOGRAM
C. L. West Aug. 1985 27 p
(AD-A166191; RSRE-MEMO-3874; DRIC-BR-98698) Avail: NTIS HC A03/MF A01 CSCL 12/1

The procedure for designing a detour phase computer generated holograms is described with particular reference to a scale and rotation invariant transformation filter known as a Mellin transform filter. Experimental results are presented which demonstrate the main features of the devices. GRA

N86-30128# Air Force Academy, Colo. Research Lab.
ADVANCED LASER BASED INERTIAL INSTRUMENT DEVELOPMENT Final Report, Jan. 1984 - Mar. 1986
James R. Rotge 1986 18 p
(AD-A166307; FJSRL-TR-86-0001) Avail: NTIS HC A02/MF A01 CSCL 17/7

Active laser gyroscopes suffer from a lock-in phenomenon, a result of backscatter from the cavity optical elements, which limit their performance in the regime of near-zero rotation. The flip-flop gyro proposed and initially investigated under this effort shows potential for minimizing or avoiding this lock-in effect. The need for a high accuracy, inexpensive and reliable clock, suitable for avionics applications was the motivation for the laser clock proposed and studied during the course of this effort. Both devices require and deserve further investigation to properly demonstrate their utility. GRA

N86-30129# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
USACRREL (US ARMY COLD REGIONS RESEARCH AND ENGINEERING LABORATORY) PRECISE THERMISTOR METER
Gary M. Trachier, James S. Morse, and Steven F. Daly Dec. 1985 39 p
(AD-A166470; CRREL-SR-85-26) Avail: NTIS HC A03/MF A01 CSCL 14/2

To facilitate the study of frazil ice in the field, a highly accurate, portable water temperature meter was required. The USACRREL Precise Thermistor Meter was designed and built to meet this need. The meter is rugged, battery-operated, waterproof, and able to operate over a wide range of ambient temperatures. A unique feature of this instrument is the use of software to compensate for temperature-dependent variation in the analog electronics. The circuitry consists of an analog printed circuit board and a low power microcomputer. The resistance of a calibrated thermistor is determined and its temperature calculated using the Steinhart-Hart equation. The accuracy of the meter was determined both theoretically and in cold room tests. The hardware and software used in the meter are described. GRA

N86-30130# Pennsylvania State Univ., University Park.
RESEARCH WITH NEARFIELD ACOUSTIC HOLOGRAPHY Final Report, 1 Aug. 1982 - 30 Sep. 1985
Julian D. Maynard Mar. 1986 18 p
(Contract N00014-82-K-0610)
(AD-A166679) Avail: NTIS HC A02/MF A01 CSCL 14/5

The main objective of the research was to characterize the potential and limitations of a new sound radiation and intensity vector field measurement technique in regard to both general theory and hardware application. The topics for study included: measurement system considerations (including array construction, data acquisition electronics, calibration of transducer elements, environmental effects, tests of the system accuracy, etc.), plane hologram data processing (including wrap-around error elimination, spatial resolution limits, zoom imaging, array processor algorithms, etc.), cylindrical and spherical data processing algorithms, wideband noise research, and holography for odd-shaped surfaces. The discovery of a technique for reconstructing radiation from odd shaped surfaces represents a major breakthrough, as it allows the use of a plane array of transducers to image the backside of a three dimensional object. GRA

N86-30131# Rockwell International Corp., Thousand Oaks, Calif. Microelectronics Research and Development Center.
INVESTIGATION OF FAST REACTION SAW (SURFACE ACOUSTIC WAVE) ACCELEROMETER Final Technical Report, 2 Oct. 1980 - 30 Sep. 1984
M. E. Motamedi Nov. 1985 54 p

(Contracts MDA903-81-C-0081; DARPA Order 4061)
(AD-A166779; MRDC41082.16FR) Avail: NTIS HC A04/MF A01 CSCL 17/7

The objective is to develop surface acoustic wave (SAW) accelerometers with improved bias stability characteristics for moderately accurate inertial navigation. Methods of fabricating dual-resonator crystals with low absolute and differential aging characteristics have been developed. Tests have been performed at 10 Gs acceleration on integrated noise levels for simulated guidance system mission times of up to 20 min. Error rates less than 15 meters per hour in position of accuracy and velocity error less than 0.013 m/s have been achieved. Sensor device has a frequency stability of part in 10 to the 10th power with a dynamic range of 10 to the 6th power. Simulation shows a bit quantization of 0.0013 m/s and frequency scale factor of 770 Hz/m/sq s can be achieved. The concept of SAW accelerometer is based on construction of a SAW resonator on the surface of a piezoelectric quartz cantilever beam. Acceleration loading of the beam induces a surface strain in the resonator areas, resulting in a deviation of the center frequency. This frequency change is proportional to the acceleration input and it provides an inherent direct frequency digital output for the signal processing of the device.Author (GRA)

N86-30132# Department of the Air Force, Washington, D.C.
ROCKET EXHAUST PROBE Patent Application
Philip A. Kessel, inventor (to Air Force) Filed 10 Jan. 1986 17 p
(AD-D012224; US-Patent-Appl-SN-817714) Avail: NTIS HC A02/MF A01 CSCL 14/2

Disclosed is a rocket exhaust probe for collecting particulates from a rocket exhaust plume. The probe comprises a tungsten nose tip, a tip holder, a probe body, and a tail section. Rocket exhaust gas enters the probe at the nose tip inlet and passes into a mixing chamber where the exhaust gas mixes with an inert cooling gas that cools and decelerates the exhaust gas. The mixture of exhaust gas and inert gas then passes into a diffusion chamber where it further cools and decelerates before passing through a submicron particle collection filter. GRA

N86-30133# Department of the Air Force, Washington, D.C.
FATIQUE TEST MACHINE Patent Application
David I. G. Jones, inventor (to Air Force) Filed 6 Dec. 1985 14 p
(AD-D012232; US-Patent-Appl-SN-805518) Avail: NTIS HC A02/MF A01 CSCL 20/11

This invention relates to an apparatus for testing materials under combined static and dynamic loads. Materials used in rotating components of, for example, jet engines are subjected to unusually severe environmental conditions during their operational lifetimes. Components such as disks and blades are subjected to high temperature excursions, high levels of 'steady' stress from centrifugal loads (low cycle stress), as well as high levels of high frequency 'dynamic' stress from resonant vibration response (high cycle stress). The thermal-mechanical cycling of the component material can lead to initiation and propagation of cracks at voids, defects or scratches. The crack initiation and propagation characteristics of materials used in jet engine components vary widely, according to whether the material is more or less ductile, and depend on temperature, low cycle stress, high cycle stress, frequency, dwell time, local atmospheric conditions and many other parameters. This abstract discloses fatigue testing machine for testing materials under combined static and dynamic loads. The mach ine comprises a right circular ring, a pair of specimen clamps adapted for slidably fitting into diametrically opposed openings in the ring, a support cradle for the ring and a shaker. The clamps comprises means for applying a static load to a specimen clamped therebetween. GRA

N86-30134# Varian Associates, Palo Alto, Calif.
INFRARED MONITORING OF GYROTRON WINDOWS
H. Huey, L. Ives, N. Lopez, and L. Mundie 1985 11 p Presented at the Infrared Information Exchange, New Orleans, La., 1 Oct. 1985
(Contract DE-AC05-84OR-21400)
(DE86-002449; CONF-8510202-1) Avail: NTIS HC A02/MF A01

Ceramic and single crystal windows for the transmission of high average power (greater than 50 kW) microwave and millimeter wave tubes such as the gyrotron are a key limitation in practical tube development. Thermal stresses can be calculated by computer modeling, but various assumptions lead to large uncertainties. To determine the actual window condition, a technique for monitoing the temperature distribution over the window surface with an ir camera while the gyrotron is in operation has been developed. The ir camera views the window through a perforated waveguide wall and serves both as a guide for the safe opearation of the gyrontron, as well as an aid in the analysis of new window designs. The technique is applicable to many types of high average power microwave and millimeter wave tubes. DOE

N86-30590*# Chicago Univ., Ill. Lab. for Astrophysics and Space Research.
A NEW INSTRUMENT TO MEASURE CHARGED AND NEUTRAL COMETARY DUST PARTICLES AT LOW AND HIGH IMPACT VELOCITIES
T. Economon, J. A. Simpson, and A. J. Tuzzolino *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 54-55 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30606*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CAPACITOR-TYPE MICROMETEOROID DETECTORS
J. J. Wortman (North Carolina State Univ., Raleigh.), D. P. Griffis (North Carolina Univ., Chapel Hill.), S. R. Bryan, and W. Kinard *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 94-96 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

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Includes parametric amplifiers.

N86-30135*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
A 3-COMPONENT LASER-DOPPLER VELOCIMETER DATA ACQUISITION AND REDUCTION SYSTEM
L. C. Rodman, J. H. Bell, and R. D. Mehta Aug. 1985 86 p
(Contract NCC2-294)
(NASA-CR-176929; NAS 1.26:176929; JIAA-TR-63) Avail: NTIS HC A05/MF A01 CSCL 20E

A laser doppler velocimeter capable of measuring all three components of velocity simultaneously in low-speed flows is described. All the mean velocities, Reynolds stresses, and higher-order products can be evaluated. The approach followed is to split one of the two colors used in a 2-D system, thus creating a third set of beams which is then focused in the flow from an off-axis direction. The third velocity component is computed from the known geometry of the system. The laser optical hardware and the data acquisition electronics are described in detail. In addition, full operating procedures and listings of the software (written in BASIC and ASSEMBLY languages) are also included. Some typical measurements obtained with this system in a vortex/mixing layer interaction are presented and compared directly to those obtained with a cross-wire system. M.G.

N86-30136*# CLS Laser Systems, Inc., South Windsor, Conn.
NASA LIDAR SYSTEM SUPPORT AND MOPA TECHNOLOGY DEMONSTRATION Final Report
L. M. Laughman, B. Capuano, and R. J. Wayne Aug. 1986 88 p
(Contract NAS1-17127)
(NASA-CR-178144; NAS 1.26:178144) Avail: NTIS HC A05/MF A01 CSCL 20E

A series of lidar design and technology demonstration tasks in support of a CO2 lidar program is discussed. The first of these

tasks is discussed in Section VI of this report under the heading of NASA Optical Lidar Design and it consists of detailed recommendations for the layout of a CO2 Doppler lidar incorporating then existing NASA optical components and mounts. The second phase of this work consisted of the design, development, and delivery to NASA of a novel acousto-optic laser frequency stabilization system for use with the existing NASA ring laser transmitter. The second major task in this program encompasses the design and experimental demonstration of a master oscillator-power amplifier (MOPA) laser transmitter utilizing a commercially available laser as the amplifier. The MOPA design including the low chirp master oscillator is discussed in detail. Experimental results are given for one, two and three pass amplification. The report includes operating procedures for the MOPA system.Author

N86-30137# Sigma Tau Standards Corp., Tuscaloosa, Ala.
LIGHT-WEIGHT HYDROGEN MASER Final Report, Mar. 1979 - Jul. 1984
Harry E. Peters Dec. 1985 22 p
(Contract F19628-79-C-0104)
(AD-A165850; RADC-TR-85-262) Avail: NTIS HC A02/MF A01 CSCL 20/5

Based upon a new approach to cavity resonator and atom storage assembly design, experimental work was undertaken to develop a much smaller and lighter hydrogen maser frequency standard. An operational prototype maser of light-weight and small size resulted, but the new cavity and bulb design did not result in improved stability. Upon knowledge gained in this program further work funded by other government agencies has resulted in successful hydrogen maser oscillators having unprecedent frequency stability. GRA

N86-30138# Washington State Univ., Pullman.
INVESTIGATION OF BASIC CHARACTERISTICS OF LASER HEATING IN THERMOLUMINESCENCE AND OF LASER-STIMULATED LUMINESCENCE Annual Report, 15 Jul. 1985 - 15 Jul. 1986
Peter F. Braunlich, Abdollah Abtahi, Paul Kelly, and M. Runkel 18 Mar. 1986 92 p
(Contract N00014-82-K-0529; RRO-1107)
(AD-A166089) Avail: NTIS HC A05/MF A01 CSCL 20/13

A general solution of the heat diffusion equation is presented for the case of a semi-infinite two-layer system that is heated with a localized cw laser beam of Gaussian or uniform circular intensity profile. As an example, this theory is applied to thin layers of a thermoluminescent material on a substrate. The transident thermoluminescence emission response is calculated and compared with experimental results, illustrating the validity of oxide-semiconductor sandwiches, which are discussed. The theory of heating a semi-infinite two-layer system with a localized CO2 laser beam of uniform circular intensity profile is also applied to configurations consisting of thin thermoluminescent LiF; Ti, Mg phosphor layers on borosilicate glass substrates. Two optically stimulable phosphors (MgS:Ce, Sm and CaS;Ce, Sm) have been developed with the goal to eventually apply them to imaging of neutron dose distributions. These phosphors exhibit luminescence emission spectra that are different for UV excitation and for IR stimulation, a property necessary for nearly real-time radiography. GRA

N86-30139# Stanford Univ., Calif. Lab. of Physics.
STUDIES ON RADIATIVE COLLISIONAL AND ULTRAVIOLET LASERS Final Technical Report, Oct. 1982 - Sep. 1985
S. E. Harris and J. F. Young Nov. 1985 24 p
(Contract F49620-83-C-0016)
(AD-A166193; AFOSR-86-0011TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

Significant accomplishments of this program include: the first microwave pumping of an excimer laser; the first use of pulsed hollow cathode technology to produce substantial quantities of core excited metastable atoms; the use of these metastable atoms to delineate a partial Grotrian diagram for core excited sodium; the proposal of the concept of quasi-metastable quartet levels and the experimental verification of their importance in the column I metals; and the proposal for short wavelength systems based on super Coster Kronig transitions. GRA

N86-30140# Avco-Everett Research Lab., Mass.
PULSED CHEMICAL LASER TECHNOLOGY DEVELOPMENT TEST PLAN SINGLE PULSE DIAGNOSTIC TESTING
James P. Moran 15 Apr. 1986 18 p
(Contract DAAH01-83-C-0282)
(AD-A166203) Avail: NTIS HC A02/MF A01 CSCL 20/5

Single pulse DF and DF/CO2 transfer laser testing will be conducted to expand the data base for verification and extension of performance scaling relations. Scaling relations are currently based on the analytical effort completion under Task I and the comparison of this analysis with the available data. Tests will explore the effects on performance of gas composition with constituents included F2, D2, O2, HF, NF3, He, N2, and CO2 at both DF and CO2 wavelengths. Tests will explore the nature of the medium in terms of F atom initiation level and gain, the nature of the initiating electron beam source in terms of energy deposition level and uniformity and pulse length, and laser yield in terms of total energy, pulse shape and time resolved spectra. The system will operate at pressures ranging from 200 to 760 torr. GRA

N86-30141# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A HIGH REPETITION RATE AND MODE-LOCKED PHOSPHATE GLASS LASER
Huijuan He, Guoxian Lu, Yongchun Li, Linxin Qian, and Shenru Gu 4 Apr. 1986 12 p Transl. into ENGLISH from Zhong Guo Jiguang (China), v. 11, no. 7, 1984 p 385-388
(AD-A166303; FTD-ID(RS)T-0003-86) Avail: NTIS HC A02/MF A01 CSCL 20/5

High repetition rate operation of a picosecond glass laser up to 10 Hz was achieved by using a new kind of phosphate glass. The pulse duration is 24 ps, the spectral width is 0.84 A and the total energy of the pulse train is 6 mJ. The key to the operation of glass materials at high repetition rates lies not only in an improvement of their thermal conductivity, but also in an avoidance or elimination of the undesired optical pumping induced thermal effects, such as the optical path change due to change in the index of refraction with temperature, and the linear expansion coefficient. For silicate glass, both are positive. The new-type of phosphate glass adopted in our laboratory exhibits negative and positive linear expansion coefficient behavior, so that changes in the optical path resulting from both of them can be compensated by each other. As a result, such a change can reach a minimum value each time when light travels back and forth in a laser cavity. GRA

N86-30142# Litton Systems, Inc., Morris Plains, N. J. Airtron Div.
INVESTIGATION OF OXIDE AND FLUORIDE HOSTS FOR BLUE-GREEN LASERS Final Report, 1 Oct. 1982 - 31 Jan. 1985
R. F. Belt, R. Uhrin, and E. Niemczyk Aug. 1985 66 p
(Contract N00014-83-C-0072)
(AD-A166620) Avail: NTIS HC A04/MF A01 CSCL 20/5

Mixed crystals of the perovskite type structure of the system La A1(1-x) Sc(x) O3 were examined over the compositions of x=0.15-0.30. Single crystals were grown from melts in iridium crucibles using the Czochralski method. Seed crystals of (111) pure La A1 O3 were used. The growth atmosphere was controlled at 99.75% N2 and 0.25% H2. Dopants of Ce(3+) were maintained at 0.01-0.05 atomic per cent. Preliminary work on polycrystalline materials showed that blue-green luminescence at 485 nm was found. The grown crystals had various amounts of Sc incorporated and were usually translucent. At the x=.30 formulation of melt, about 60-75% of Sc is believed to enter the crystal. No direct evidence was found for ordered type structures. The phase data, compositions, crystal quality, luminescence data, and x-ray results are discussed. Several mixed fluorides were examined for

possible blue-green emission by doping with rare earths. Among the host compositions was K Mg Y3 F12, a crystal which could be doped with transition elements and rare earths. A sizeable effort provided fairly good single crystal s for future seeds. Several polycrystalline preparations were made with Ce(3+), Pr(3+), Ti(3+), Nd(3+), Cr(3+), and Er(3+). GRA

N86-30143# Department of the Air Force, Washington, D.C.
A CONDUCTIVELY COOLED LASER DIODE ARRAY PUMPED LASER Patent Application
Larry K. Conaway, inventor (to Air Force) Filed 10 Jan. 1986 17 p
(AD-D012217; US-Patent-Appl-SN-817637) Avail: NTIS HC A02/MF A01 CSCL 20/5

A conductively cooled semiconductor laser comprises a laser rod surrounded by arrays of laser diodes. The laser diodes are mounted to ceramic plates that are excellent heat extractors and electrical insulators. The ceramic plates have steps which permit diode mounting without plate to plate interference when the plates are assembled into the arrays. Conductive coatings on selected portions of the ceramic plates are used to electrically connect the diodes. GRA

N86-30144# Los Alamos National Lab., N. Mex.
CRITICAL REVIEW OF GAMMA-RAY LASER PROPOSALS
G. C. Baldwin 1985 5 p Presented at the International Laser Science Conference, Dallas, Tex., 18 Nov. 1985
(Contract W-7405-eng-36)
(DE86-006020; LA-UR-86-192; CONF-851185-8) Avail: NTIS HC A02/MF A01

Laser sources generating sub-nm radiation, using recoilless nuclear transitions in solids, have been proposed for years. This review examines, from the standpoint of kinetics, many solutions (e.g., narrowed line, explosive neutron pump, two-stage pump, two-step pump) that have been proposed for the basic problem: that pumping can inhibit or destroy the Moessbauer and Borrman effects, which are essential for gain. DOE

N86-30145# KMS Fusion, Inc., Ann Arbor, Mich.
NON-LTE ATOMIC PHYSICS MODEL FOR LASER FUSION AND X-RAY LASER SIMULATION
P. M. Campbell Aug. 1985 28 p
(Contract DE-AC08-82DP-40152)
(DE86-006487; KMSF-U-1662) Avail: NTIS HC A03/MF A01

In this report a method for calculating nonequilibrium atomic physics parameters in hot plasmas is described. This type of calculation is necessary for accurate simulation of laser fusion target experiments, where, generally, outside the ablation surface the target is non-LTE (Local Thermal Equilibrium). Another problem of interest in which non-LTE is important is in x-ray laser experiments. Here the whole process of interest depends on achieving a non-equilibrium atomic state, namely, a population inversion in selected atomic levels. The present model should provide a valuable calculational tool in support of several areas important to KMS programs. DOE

N86-30146# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NONLINEAR THEORY OF THE FREE-ELECTRON LASER
A. C.-L. Chian and A. dePaduaBrito Serbeto 1984 12 p
(DE86-700668; INPE-3193) Avail: NTIS (US Sales Only] HC A02/MF A01

A theory of Raman free-electron laser using a circularly polarized electromagnetic pump is investigated. Coupled wave equations that describe both linear and nonlinear evolution of stimulated Raman scattering are derived. The dispersion relation and the growth rate for the parametric instability are obtained. Nonlinear processes that may lead to saturation of the free-electron laser are discussed. DOE

N86-30147# Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo (Brazil).
DEVELOPMENT OF A SOLID STATE LASER OF Nd:YLF M.S. Thesis
R. doAmaralNeto 1984 99 p In PORTUGUESE
(DE86-700770; INIS-BR-401) Avail: NTIS (US Sales Only) HC A05/MF A01

The CW laser action was obtained at room temperature of a Nd:YLF crystal in an astigmatically compensated cavity, pumped by an argon laser. This laser was completely projected, constructed and characterized in our laboratories. It initiates a broader project on laser development that will have several applications like nuclear fusion, industry, medicine, telemetry, etc. Throught the study of the optical properties of the Nd:YLF crystal, laser operation was predicted using a small volume gain medium on the mentioned cavity, pumped by an Ar 514,5 nm laser line. To obtain the laser action at polarizations sigma (1,053 (MU)m) and (PI) (1.047 (MU)m) an active medium was prepared which was a crystalline plate with a convenient crystallographic orientation. The laser characterization is in reasonable agreement with the initial predictions. For a 3.5% output mirror transmission, the oscillation threshold is about 0.15 W incident on the crystal, depending upon the sample used. For 1 W of incident pump light, the output power is estimated to be 12 mw, which corresponds to almost 1.5% slope efficiency. The versatile arrangement is applicable to almost all optically pumped solid state laser materials. DOE

N86-30148# Lawrence Livermore National Lab., Calif.
THEORY AND ANALYSIS OF SOFT X-RAY LASER EXPERIMENTS
B. L. Whitten and A. U. Hazi Oct. 1985 15 p Presented at the 7th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, Calif., 28 Oct. 1985
(Contract W-7405-eng-48)
(DE86-005177; UCRL-93829; CONF-851053-11) Avail: NTIS HC A02/MF A01

The atomic modeling of soft X-ray laser schemes presents a formidable challenge to the theorists - a challenge magnified by the recent successful experiments. A complex plasma environment with many ion species present must be simulated. Effects such as turbulence, time dependence, and radiation transport, which are very difficult to model accurately, may be important. We shall describe our efforts to model the recently demonstrated soft X-ray laser in collisionally pumped neon-like selenium, with emphasis on the ionization balance and excited state kinetics. The relative importance of various atomic processes, such as collisional excitation and dielectronic recombination, on the inversion kinetics will be demonstrated. We shall compare our models with experimental results and evaluate the success of this technique in predicting and analyzing the results of X-ray laser experiments. DOE

N86-30149# California Univ., Berkeley. Lawrence Berkeley Lab.
DESIRABLE EXCITATION PATTERNS FOR TAPERED WIGGLERS
K. Halbach Nov. 1985 19 p Presented at the 7th International Free-Electron Laser Conference, Tahoe City, Calif., 8 Sep. 1985
(Contract DE-AC03-76SF-00098)
(DE86-005997; LBL-20564; CONF-850956-21) Avail: NTIS HC A02/MF A01

Angular and displacement errors associated with excitation patterns of tapered wigglers will be discussed, and patterns will be described that do not lead to such errors even when the energy of the electrons changes along the length of the wiggler, and when the real excitation is different from the ideal excitation because of systematic iron saturation. DOE

N86-30150# Los Alamos National Lab., N. Mex.
NUCLEAR STRUCTURE PROPERTIES FOR GAMMA-RAY LASERS
D. D. Strottman, E. D. Arthur, and D. G. Madland 1985 5 p Presented at the International Laser Science Conference, Dallas, Tex., 18 Nov. 1985
(Contract W-7405-eng-36)
(DE86-006027; LA-UR-86-249; CONF-851185-11) Avail: NTIS HC A02/MF A01

We summarize some initial results in our investigation of the nuclear physics issues of gamma-ray lasers. We describe what is known thus far from existing experimental data and illustrate how theoretical models may be employed for systematic searches of candidate nuclei. DOE

N86-30151# Rice Univ., Houston, Tex. Dept. of Chemistry.
LASER IGNITION STUDIES
L. Fredin, G. P. Hansen, J. L. Margrave, and R. G. Behrens Oct. 1985 9 p Presented at the DARPA/ARMY Symposium, Daytona Beach, Fla., 21 Oct. 1985 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE86-006043; LA-UR-86-383; CONF-8510280-5) Avail: NTIS HC A02/MF A01

The goal of this work is to study the details of laser induced ignition and combustion of high-temperature condensed-phase exothermic reactions. In this work high-speed photography (HSP) and real-time optical pyrometry have been combined to provide a diagnostic tool with a 1 ms temporal resolution for studying laser ignition and combustion wave propagation. Previous experiments have involved the use of HSP for studying combustion wave propagation (1) Real-time pyrometry studies of the ignition process have also been performed previously. The present paper describes how HSP has been expanded to include three-view split-frame photography to allow the ignition and combustion processes to be recorded and studied simultaneously. DOE

N86-30152# Brookhaven National Lab., Upton, N. Y.
FREQUENCY QUADRUPLED Nd-Ysg LASTER FOR LEGS
D. H. Dowell, G. Giordano, O. Kistner, G. Matone, A. M. Sandorfi, C. Schaerf, and C. E. Thorn 1985 6 p
(Contract DE-AC02-76CH-00016)
(DE86-006133; BNL-37623) Avail: NTIS HC A02/MF A01

In the backscattering experiment of laser light against high energy electrons at BNL Laser Electron Gamma Source (LEGS) it is planned to use an argon ion laser tuned on the 351.1 nm wave length. It is proposed to quadruple the infrared line of a Nd-YAG laser to the uv-line of 266 nm by using two crystals: a KTP for the transition ir (YIELDS) green and D-KDP for the transition green (YIELDS) uv. Modifications of the system are summarized. It is proposed that a feasibility study be started. DOE

N86-30153# Oak Ridge National Lab., Tenn.
LASER INDUCED OXIDATION OF HEAVILY DOPED SILICON
E. Fogarassy (Centre de Recherches Nucleaires, Strasbourg (France).), C. W. White, D. H. Lowndes, and J. Narayan 1985 7 p Presented at the Symposium on Phase Transitions in Condensed Systems: Experiments and Theory, Pittsburgh, Pa., 2 Dec. 1985 Prepared in cooperation with Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires.
(Contract DE-AC05-84OR-21400)
(DE86-006212; CONF-851260-2) Avail: NTIS HC A02/MF A01

We have investigated the incorporation of oxygen into heavily doped silicon during uv excimer laser irradiation. For the case of repetitive laser irradiations in air, the amount of oxygen incorporated into Si depends markedly on the dopant. For As and Sb implanted silicon, there is no anomalous oxygen incorporation. By contrast, increasing amounts of O are incorporated into In implanted silicon as a function of number of laser shots. The incorporation of O is associated with degradation of the optical and structural properties of the surface, and a deep diffusion of the dopant. This behavior is believed to be partly related to specific chemical reactions between oxygen and indium present in the surface at high concentrations as the result of dopant segregation during solidification. DOE

N86-30154# Oak Ridge National Lab., Tenn.
DITHER-FREE STABILIZATION OF CO2 LASERS FOR FAR INFRARED PUMPING: A PHOTOACOUSTIC APPROACH
C. A. Bennett, Jr. and D. P. Hutchinson Feb. 1986 10 p
(Contract DE-AC05-84OR-21400)
(DE86-007078; ORNL/TM-9830) Avail: NTIS HC A02/MF A01

A method based on the photoacoustic technique is described for dither-free frequency stabilization of the optical pump in a CH3OH laser operating at 119 (MU)m. Heterodyne measurements on two independently locked far infrared radiation (FIR) lasers indicate excellent long term frequency and power stability. This stabilization scheme should be applicable to all optially pumped FIR lasants. DOE

N86-30155# Lawrence Livermore National Lab., Calif.
CHARACTERIZATION OF HIGH POWER FLASHLAMPS AND APPLICATION TO Nd:GLASS LASER PUMPING
H. T. Powell, A. C. Erlandson, and K. S. Jancaitis 17 Jan. 1986 58 p Presented at the Los Angeles Symposium and Exhibition on Optical and Electro-Optical Engineering, Los Angeles, Calif., 19 Jan. 1986
(Contract W-7405-eng-48)
(DE86-007116; UCRL-94147; CONF-860117-5) Avail: NTIS HC A04/MF A01

Detailed spectral and temporal measurements of the output radiation from Xe flashlamps are reported together with their use in predicting the pumping efficiency of Nd-doped laser glass. We have made absolute spectral-intensity measurements for 0.5, 1.5, and 4.2-cm-bore flashlamps for input powers ranging from 5 to 90 kW/cm(2) and pulselengths of 600 (MU)s. Under quasi-stationary conditions these flashlamps emit essentially identical spectra when excited at equal input power per unit-area of the bore. This behavior is characteristic of an optically-thick radiator although it is not completely clear why flashlamps should behave this way. A simple model is also described which accounts for the transient response of flashlamps by characterizing the output spectra and radiation efficiencies in terms of the radiant output power rather than the electrical input power. DOE

N86-30156# Lawrence Livermore National Lab., Calif.
SPECTROSCOPIC, OPTICAL AND THERMO-MECHANICAL PROPERTIES OF GSGG AND ITS LASER PERFORMANCE
W. F. Krupke Jan. 1986 8 p Presented at the International Laser Science Conference, Dallas, Tex., 18 Nov. 1985
(Contract W-7405-eng-48)
(DE86-005773; UCRL-93853; CONF-851185-6) Avail: NTIS HC A02/MF A01

Spectroscopic, optical, and thermo-mechanical properties central to the design of high average Nd:Cr: gadolinium scandium gallium garnet (GSGG) lasers are presented. The status of crystal growth and achieved laser performance levels are briefly reviewed. DOE

N86-30157# Sandia National Labs., Albuquerque, N. Mex.
NUMERICAL SIMULATION OF GAIN-GUIDED DIODE LASER ARRAYS
G. R. Hadley 1986 10 p Presented at the SPIE Technical Symposium on Applications of Artificial Intelligence, Orlando, Fla., 31 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-007833; SAND-86-0490C; CONF-860366-2) Avail: NTIS HC A02/MF A01

We present a self-consistent numerical model of light propagation in diode laser arrays. This model has been used to study the free-running modes of a five-element gain-guided array operated just below threshold. The resulting calculations show that, in contrast to index-guided arrays, the modeshapes in general bear little or no resemblance to the "supermodes" obtained previously from linear perturbation theories. In addition, we find more than 5 modes for an 5-element device, so that the intensity maxima in the near-field are not necessarily centered over the stripes. These observations are explainable in terms of a simple plane wave model of the array cavity. DOE

N86-30158# Rochester Univ., N. Y. Lab. for Laser Energetics.
LLE REVIEW, VOLUME 25 Quarterly Report, Oct. - Dec. 1985
A. Schmid, ed. 1986 60 p
(Contract DE-FC08-85DP-40200)
(DE86-008195; DOE/DP-40200/19-Vol-25) Avail: NTIS

HC A04/MF A01

This volume of the LLE Review comprises reports on the performance of the active-mirror-boosted glass development laser (GDL) single-beam system; the implementation of multichannel, soft x-ray diagnostic instrumentation; computer simulation of recent OMEGA laser implosion experiments; materials and ultrafast technology developments in the LLE advanced technology program; and the the National Laser Users Facility activities for October-December 1985. The following are some highlights of the work described in this issue: (1) The active-mirror booster stage on GDL brings single-beam, 1054-nm output energy near the kilojoule level for 1-ns pulses. (2) Measurements of soft x-ray emission from 100 to 200 eV are now possible with the help of a four-channel, GHz-bandwidth diode spectrometer, which is fully integrated into a digital data acquisition system. (3) Comparison of experimental data and predictions of one-dimensional numerical simulations of OMEGA implosion experiments reveal discrepancies that can be resolved to two-dimensional calculations. (4) The technique ofpulse chirping allows temporal stretching and recompression operations to be carried out in picosecond pulses, to amplify pulses in compact systems and avoid the dangers of optical nonlinearities due to high peak powers. (5) High-average-power glass lasers require glasses with improved thermal-shock resistance. Recent gains in ion-exchange surface treatments of a phosphate-composition glass have led to a fivefold increase in thermal-shock resistance for that glass. DOE

N86-30159# Colorado Univ., Boulder. Dept. of Physics.
NEAR RESONANT ABSORPTION BY ATOMS IN INTENSE FLUCTUATING LASER FIELDS Progress Report, 1 Aug. 1985 - 31 Jul. 1986
S. J. Smith Mar. 1986 8 p
(Contract DE-FG02-85ER-13421)
(DE86-008513; DOE/ER-13421/1) Avail: NTIS HC A02/MF A01

We have proceeded with analysis and publication of data obtained using the double optical resonance technique to study the effects of phase fluctuations in saturated absorption in a 3s-3p transition in atomic sodium. We have initiated development of techniques for observing the effects of fluctuations in resonance fluorescence radiation in the same transition, using optical heterodyning. We have investigated the possibilities for carrying out studies on a partially saturated two-photon transition in molecular sodium. The major effort has been concentrated on development and application of a technique for investigating the role of amplitude fluctuations on two-photon Doppler free absorption in the 3s-5s transition in atomic sodium. In addition, a brief collaboration with scientists from other universities addresses the question of the role of fluctuations in Hanle effect measurements. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N86-30160*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INSTABILITY IN ROTATING MACHINERY
Dec. 1985 458 p Symposium held in Carson City, Nev., 10-14 Jun. 1985; sponsored by Bently Rotor Dynamics Research Corp. (NASA-CP-2409; E-2652; NAS 1.55:2409) Avail: NTIS HC A21/MF A01 CSCL 13I

The proceedings contain 45 papers on a wide range of subjects including flow generated instabilities in fluid flow machines, cracked shaft detection, case histories of instability phenomena in compressors, turbines, and pumps, vibration control in turbomachinery (including antiswirl techniques), and the simulation and estimation of destabilizing forces in rotating machines. The symposium was held to serve as an update on the understanding and control of rotating machinery instability problems. For individual titles, see N86-30161 through N86-30204.

N86-30161*# Ingersoll-Rand Co., Phillipsburg, N.J.
FULL LOAD SHOP TESTING OF 18,000-HP GAS TURBINE DRIVEN CENTRIFUGAL COMPRESSOR FOR OFFSHORE PLATFORM SERVICE: EVALUATION OF ROTOR DYNAMICS PERFORMANCE
R. Gordon Kirk and Mark Simpson (Ingersoll-Rand Co. Ltd., Wythenshawe (England).) *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 1-13 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The results for in-plant full load testing of a 13.4 MW (18000 HP) gas turbine driven centrifugal compressor are presented and compared to analytical predictions of compressor rotor stability. Unique problems from both oil seals and labyrinth gas seals were encountered during the testing. The successful resolution of these problems are summarized. Author

N86-30162*# Stromberg-Carlson Corp., Rochester, N. Y.
INSTABILITY ANALYSIS PROCEDURE FOR 3-LEVEL MULTI-BEARING ROTOR-FOUNDATION SYSTEMS
Shixiang Zhou and Neville F. Rieger *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 15-36 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

A procedure for the instability analysis of a three-level multispan rotor systems is described. This procedure is based on a distributed mass elastic representation of the rotor system in several eight-coefficient bearings. Each bearing is supported from an elastic foundation on damped, elastic pedestals. The foundation is represented as a general distributed mass elastic structure on discrete supports, which may have different stiffness and damping properties in the horizontal and vertical directions. This system model is suited to studies of instability threshold conditions for multirotor turbomachines on either massive or flexible foundations. The instability conditions is found by obtaining the eigenvalues of the system determinant, which is obtained by the transfer matrix method from the three-level system model. The stability determinant is solved for the lowest rotational speed at which the system damping becomes zero in the complex eigenvalue, and for the whirl frequency corresponding to the natural frequency of the unstable mode. An efficient algorithm for achieving this is described. Application of this procedure to a rigid rotor in two damped-elastic bearings and flexible supports is described. A second example discusses a flexible rotor with four damped-elastic bearings. The third case compares the stability of a six-bearing 300 Mw turbine generator unit, using two different bearing types. These applications validate the computer program and various aspects of the analysis. Author

N86-30163*# Melbourne Univ., Parkville (Australia).
SIMULATION OF NON-LINEAR BEARING FORCES FOR POST-STABILITY INVESTIGATION
Z. A. Parszewski, J. M. Krodiewski, K. Krynicki, and A. E. Salek *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 37-46 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Different types of bearing designs were developed to improve dynamic properties of rotor-bearing systems. Elliptical bearings, multisleeve bearings, tilting pad and other designs such as herringbone groove were utilized to increase resistance to the onset of self excited vibrations. Experimental trials are costly, two alternative methods are used to gain a qualitative insight. The first one creates mathematical model and applies both a digital or an analog computer simulation. The second one investigates phenomena occurring on the laboratory rig with the bearing replaced by an electronic simulating device, working in a feedback loop, which produces forces,which are functions of journal displacement and velocity. The simulated hydrodynamic forces are produced according to assumed characteristics matched to the bearing type. The principal benefit of the analog simulation is that nonlinear characteristics of a subsystem are precisely identified and mathematical methods applied for a wide class of problems are checked on the experimental installation. Author

N86-30164*# Bently Rotor Dynamics Research Corp., Minden, Nev.
MEASUREMENT OF ROTOR SYSTEM DYNAMIC STIFFNESS BY PERTURBATION TESTING
Donald E. Bently and Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 47-58 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Specific aspects of the application of Modal Analysis to rotating machines are discussed. For lowest mode analysis, the circular force perturbation testing gives the best results. Examples of application are presented. Author

N86-30165*# Bently Rotor Dynamics Research Corp., Minden, Nev.
WHY HAVE HYDROSTATIC BEARINGS BEEN AVOIDED AS A STABILIZING ELEMENT FOR ROTATING MACHINES
Donald E. Bently and Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 59-64 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The advantages are discussed of hydrostatic, high pressure bearings as providers of higher margin of stability to the rotor/bearing systems. It is apparent that deliberate use of hydrostatic bearing high pressure lubricated (any gas or liquid) can easily be used to build higher stability margin into rotating machinery, in spite of the thirty years bias against high pressure lubrication. Since this supply pressure is controllable (the Direct Dynamic Stiffness at lower eccentricity is also controllable) so that within some rotor system limits, the stability margin and dynamic response of the rotor system is more readily controllable. It may be possible to take advantage of this effect in the various seals, as well as the bearings, to assist with stability margin and dynamic response of rotating machinery. The stability of the bearing can be additionally improved by taking advantage of the anti-swirling concept. The high pressure fluid supply inlets should be located tangentially at the bearing circumference and directed against rotation. The incoming fluid flow creates stability by reducing the swirling rate. E.R.

N86-30166*# Bently Nevada (UK) Ltd., Birchwood (England).
TURBINE INSTABILITIES: CASE HISTORIES
C. W. Laws *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 65-81 (For primary document see N86-30160 21-37)
Avail NTIS HC A21/MF A01 CSCL 13I

Several possible causes of turbine rotor instability are discussed and the related design features of a wide range of turbomachinery types and sizes are considered. The instrumentation options available for detecting rotor instability and assessing its severity are also discussed. Author

N86-30167*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TWO-PHASE FLOWS WITHIN SYSTEMS WITH AMBIENT PRESSURE
R. C. Hendricks, M. J. Braun (Akron Univ., Ohio.), R. L. Wheeler, III, and R. L. Mullen (Case Western Reserve Univ., Cleveland, Ohio.) *In its* Instability in Rotating Machinery (date) p 83-96 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

In systems where the design inlet and outlet pressures are maintained above the thermodynamic critical pressure, it is often assumed that two phase flows within the system cannot occur. Designers rely on this simple rule of thumb to circumvent problems associated with a highly compressible two phase flow occurring within the supercritical pressure system along with the uncertainties in rotordynamics, load capacity, heat transfer, fluid mechanics, and thermophysical property variations. The simple rule of thumb is adequate in many low power designs but is inadequate for high performance turbomachines and linear systems, where two phase regions can exist even though outlet pressure is greater than critical pressure. Rotordynamic-fluid-mechanic restoring forces depend on momentum differences, and those for a two phase zone can differ significantly from those for a single-phase zone. Using the Reynolds equation the angular velocity, eccentricity, geometry, and ambient conditions are varied to determine the point of two phase flow incipience. Author

N86-30168*# Universidade Federal de Paraiba (Brazil).
MODELING OF ELASTICALLY MOUNTED VERTICAL ROTOR
Seyyed Said Dana and Hans Ingo Weber (Universidade Estadual de Campinas, Brazil) *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 105 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The evaluation of the dynamic behavior of a rotating system is possible by means of modal parameters (Eigenvalues and Eigenvectors). A mixed analytical and experimetal approach is used to identify the modal parameters of a specially designed test rig. The modal identification is done both for nonrotating as well as rotating systems. These modal parameters are used to validate a developed Finite Element Model. Author

N86-30169*# Texas A&M Univ., College Station.
EXPERIMENTAL VERIFICATION AND PRACTICAL APPLICATION OF TORQUEWHIRL THEORY OF ROTORDYNAMIC INSTABILITY
J. M. Vance, S. T. Noah, and K. B. Yim (Sundstrand Corp., Rockford, Ill.) *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 107-123 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

A theory developed by Vance in 1978 to explain the destabilizing effect of torque on a whirling rotor was experimentally verified. The measurements made on a specially designed test apparatus are described. New computer models were also developed to investigate the effect of torque on rotordynamic stability of multidisk flexible rotor bearing systems. The effect of torque was found to be most pronounced when the system is already marginally stable from other influences. The modifications required to include torque in a typical shaft transfer matrix are described, and results are shown which identify the type of rotor design most sensitive to load torque. Author

N86-30170*# Liaohe Chemical Fertilizer Plant, Panjin (China).
CO2 COMPRESSOR VIBRATION AND CAUSE ANALYSIS
Yin Lin Ying *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 125-133 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The operational experience of a large turbine drive carbon dioxide compressor train in a urea plant with capacity of 1620 tons/day is considered. After the initial start-up in 1976, the vibration in the HP cylinder was comparatively serious. The radial vibration reached 4.2 to 4.5 mils and fluctuated around this value. It was attributed to the rotating stall based on the spectrum analysis. Additional return line from the 4th to 4th and higher temperature of the 4th inlet has cured the vibration. Problems are described which were encountered in the operation along with their solutions, and/or improvements. Author

N86-30171*# North Staffordshire Polytechnic, Stafford (England).
INFLUENCE OF DESIGN PARAMETERS ON OCCURENCE OF OIL WHIRL
Peter J. Ogrodnik, Michael J. Goodwin, and John E. T. Penny (Aston Univ., Birmingham England) *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 135-144 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Oil whirl instability is a serious problem in oil lubricated journal bearings. The phenomenon is characterized by a subsynchronous vibration of the journal within the bush and is particularly apparent in turbogenerators, aeroengines and electric motors. A review is presented of previous papers on the subject of oil whirl, and a simple theory is described which was used to aid the design of

an oil whirl test rig. Predictions of the onset of oil whirl made by the theory presented were found to agree with those of previous researchers. They showed that increasing the shaft flexibility, or the lubricant viscosity, and decreasing the bearing radial clearance tended to reduce the oil whirl onset speed thus making the system more unstable. Author

N86-30172*# Concordia Univ., Montreal (Quebec).
BACKWARD WHIRL IN A SIMPLE ROTOR SUPPORTED ON HYDRODYNAMIC BEARINGS
R. Subbiah, R. B. Rhat, T. S. Sankar, and J. S. Rao (Embassy of India, Washington, D.C.) *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 145-153 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The asymmetric nature of the fluid film stiffness and damping properties in rotors supported on fluid film bearings causes a forward or a backward whirl depending on the bearing parameters and the speed of the rotor. A rotor was designed to exhibit backward synchronous whirl. The rotor-bearing system exhibited split criticals, and a backward whirl was observed between the split criticals. The orbital diagrams show the whirl pattern. Author

N86-30173*# Bently Rotor Dynamics Research Corp., Minden, Nev.
WHIRL AND WHIP: ROTOR/BEARING STABILITY PROBLEMS
Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 155-177 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

A mathematical model of a symmetric rotor supported by one rigid and one fluid lubricated bearing is proposed. The rotor model is represented by generalized (modal) parameters of its first bending mode. The rotational character of the bearing fluid force is taken into account. The model yields synchronous vibrations due to rotor unbalance as a particular solution of the equations of motion, rotor/bearing system natural frequencies and corresponding self-excited vibrations known as oil whirl and oil whip. The stability analysis yields rotative speed threshold of stability. The model also gives the evaluation of stability of the rotor synchronous vibrations. In the first balance resonance speed region two more thresholds of stability are yielded. The width of this stability region is directly related to the amount of rotor unbalance. The results of the analysis based on this model stand with very good agreement with field observations of rotor dynamic behavior and the experimental results. Author

N86-30174*# Kaiserslautern Univ. (West Germany).
SOME NEW RESULTS CONCERNING THE DYNAMIC BEHAVIOR OF ANNULAR TURBULENT SEALS
H. Massmann and R. Nordmann *In* NASA. Lewis Research center Instability in Rotating Machinery Dec. 1985 p 179-194 Sponsored in part by Deutsche Forschungsgemeinschaft, West Germany (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The dynamic characteristics of annular turbulent seals applied in high pressure turbopumps can be described by stiffness, damping, and inertia coefficients. An improved procedure is presented for determining these parameters by using measurements made with newly developed test equipment. The dynamic system seal, consisting of the fluid between the cylindrical surfaces of the rotating shaft and the housing, is excited by test forces (input), and the relative motion between the surfaces (output) is measured. Transformation of the input and output time signals into the frequency domain leads to frequency response functions. An analytical model, depending on the seal parameters, is fitted to the measured data in order to identify the dynamic coefficients. Some new results are reported that show the dependencies of these coefficients with respect to the axial and radial Reynolds numbers and the geometrical data of the seal. Author

N86-30175*# Stevens Inst. of Tech., Hoboken, N. J.
ANALYTICAL PREDICTION OF LABYRINTH-SEAL-FLOW-INDUCED AROTOR EXCITATION FORCES
C. Rajakumar and E. Sisto *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 195-203 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

An analytical method to calculate the rotor excitation forces arising from labyrinth seals is presented. The objective is to model the gas flow through the seal clearance passages and cavities when the rotor is positioned eccentricly relative to the stator center. The seal flow model used in the analysis yields solutions which validate the experimentally observed influence of seal parameters on seal forces reported in the literature. The analytically predicted seal pressure distributions and forces were compared with published experimental results. Author

N86-30176*# Virginia Univ., Charlottesville.
OIL SEAL EFFECTS AND SUBSYNCHRONOUS VIBRATIONS IN HIGH-SPEED COMPRESSORS
Paul E. Allaire and John A. Kocur, Jr. *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 205-223 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Oil seals are commonly used in high speed multistage compressors. If the oil seal ring becomes locked up against the fixed portion of the seal, high oil film crosscoupled stiffnesses can result. A method of analysis for determining if the oil seals are locked up or not is discussed. The method is then applied to an oil seal in a compressor with subsynchronous vibration problems. Author

N86-30177*# Arizona State Univ., Tempe.
EFFECT OF COULOMB SPLINE ON ROTOR DYNAMIC RESPONSE
C. Nataraj, H. D. Nelson, and N. Arakere *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 225-233 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

A rigid rotor system coupled by a coulomb spline is modelled and analyzed by approximate analytical and numerical analytical methods. Expressions are derived for the variables of the resulting limit cycle and are shown to be quite accurate for a small departure from isotropy. Author

N86-30178*# Liaoyang Petrochemical Fibre Co., Liaoning (China).
ROTOR-TO-STATOR RUB VIBRATION IN CENTRIFUGAL COMPRESSOR
Jin Ji Gao and Qi Min Qi *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 235-244 (For primary document see N86-30160 21-37)
Avail NTIS HC A21/MF A01 CSCL 13I

One example of excessive vibration encountered during loading of a centrifugal compressor train (H type compressor with HP casing) is discussed. An investigation was made of the effects of the dynamic load on the bearing stiffness and the rotor-bearing system critical speed. The high vibration occurred at a 'threshold load,' but the machine didn't run smoothly due to rubs even when it had passed through the threshold load. The acquisition and discussion of the data taken in the field as well as a description of the case history which utilizes background information to identify the malfunction conditions is presented. The analysis shows that the failures, including full reverse precession rub and exact one half subharmonic vibration, were caused by the oversize bearings and displacement of the rotor center due to foundation deformation and misalignment between gear shafts, etc. The corrective actions taken to alleviate excessive vibration and the problems which remain to be solved are also presented. Author

N86-30179*# Qinghua Univ. (China).
MEASURING DYNAMIC OIL FILM COEFFICIENTS OF SLIDING BEARING
Guanping Feng and Xikuan Tang *In* NASA. Lewis Research center Instability in Rotating Machinery Dec. 1985 p 245-251 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

A method is presented for determining the dynamic coefficients of bearing oil film. By varying the support stiffness and damping, eight dynamic coefficients of the bearing were determined. Simple and easy to apply, the method can be used in solving practical machine problems. Author

N86-30180*# Westinghouse Electric Corp., Cheswick, Pa.
CRACKED SHAFT DETECTION ON LARGE VERTICAL NUCLEAR REACTOR COOLANT PUMP
L. Stanley Jenkins *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 253-265 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Due to difficulty and radiation exposure associated with examination of the internals of large commercial nuclear reactor coolant pumps, it is necessary to be able to diagnose the cause of an excessive vibration problem quickly without resorting to extensive trial and error efforts. Consequently, it is necessary to make maximum use of all available data to develop a consistent theory which locates the problem area in the machine. This type of approach was taken at Three Mile Island, Unit #1, in February 1984 to identify and locate the cause of a continuously climbing vibration level of the pump shaft. The data gathered necessitated some in-depth knowledge of the pump internals to provide proper interpretation and avoid misleading conclusions. Therefore, the raw data included more than just the vibration characteristics. Pertinent details of the data gathered is shown and is necessary and sufficient to show that the cause of the observed vibration problem could logically only be a cracked pump shaft in the shaft overhang below the pump bearing. Author

N86-30181*# Borg-Warner Industrial Products, Inc., Long Beach, Calif.
PUMP INSTABILITY PHENOMENA GENERATED BY FLUID FORCES
S. Gopalakrishnan *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 267-276 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Rotor dynamic behavior of high energy centrifugal pumps is significantly affected by two types of fluid forces; one due to the hydraulic interaction of the impeller with the surrounding volute or diffuser and the other due to the effect of the wear rings. The available data on these forces is first reviewed. A simple one degree-of-freedom system containing these forces is analytically solved to exhibit the rotor dynamic effects. To illustrate the relative magnitude of these phenomena, an example of a multistage boiler feed pump is worked out. It is shown that the wear ring effects tend to suppress critical speed and postpone instability onset. But the volute-impeller forces tend to lower the critical speed and the instability onset speed. However, for typical boiler feed pumps under normal running clearances, the wear ring effects are much more significant than the destabilizing hydraulic interaction effects. Author

N86-30182*# Tennessee Valley Authority, Soddy-Daisy.
VERTICAL REACTOR COOLANT PUMP INSTABILITIES
Robert M. Jones *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 277-286 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The investigation conducted at the Tennessee Valley Authority's Sequoyah Nuclear Power Plant to determine and correct increasing vibrations in the vertical reactor coolant pumps is described. Diagnostic procedures to determine the vibration causes and evaluate the corrective measures taken are also described. Author

N86-30183*# Massachusetts Inst. of Tech., Cambridge.
PREDICTION OF DESTABILIZING BLADE TIP FORCES FOR SHROUDED AND UNSHROUDED TURBINES
Yuan J. Qiu and M. MartinezSanchez *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 287-299 (For primary document see N86-30160 21-37)
(Contract NAS8-35018)
Avail: NTIS HC A21/MF A01 CSCL 13I

The effect of a nonuniform flow field on the Alford force calculation is investigated. The ideas used here are based on those developed by Horlock and Greitzer. It is shown that the nonuniformity of the flow field does contribute to the Alford force calculation. An attempt is also made to include the effect of whirl speed. The values predicted by the model are compared with those obtained experimentally by Urlicks and Wohlrab. The possibility of using existing turbine tip loss correlations to predict beta is also exploited. The nonuniform flow field induced by the tip clearnance variation tends to increase the resultant destabilizing force over and above what would be predicted on the basis of the local variation of efficiency. On the one hand, the pressure force due to the nonuniform inlet and exit pressure also plays a part even for unshrouded blades, and this counteracts the flow field effects, so that the simple Alford prediction remains a reasonable approximation. Once the efficiency variation with clearance is known, the presented model gives a slightly overpredicted, but reasonably accurate destabilizing force. In the absence of efficiency vs. clearance data, an empirical tip loss coefficient can be used to give a reasonable prediction of destabilizing force. To a first approximation, the whirl does have a damping effect, but only of small magnitude, and thus it can be ignored for some purposes. E.R.

N86-30184*# Bently Rotor Dynamics Research Corp., Minden, Nev.
IDENTIFICATION OF BEARING AND SEAL DYNAMIC STIFFNESS PARAMETERS
Donald E. Bently and Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 301-315 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The results are presented of two simple tests, mainly steady state load test and squeeze film test, for establishing the coefficients of bearings and seals. It also discusses the methodology of the tests and some observed conclusions from the obtained data. Perturbation testing results are given as an example of verification and proof of validity of the two previous tests. Author

N86-30185*# Ecole Polytechnique Federale, Zurich (Switzerland).
MAGNETIC BEARINGS FOR VIBRATION CONTROL
G. Schweitzer *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 317-326 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

A survey is presented on the research of the Institute of Mechanics of the ETH in the field of vibration control with magnetic bearings. It shows a method for modelling an elastic rotor so that it can be represented by a low order model amenable to control techniques. It deals with the control law and spill-over effects, and it also discusses experimental results for an active resonance damper. Author

N86-30186*# Ingersoll-Rand Co., Phillipsburg, N.J.
ACTIVE MAGNETIC BEARINGS FOR OPTIMUM TURBOMACHINERY DESIGN
Jerry Hustak, R. Gordon Kirk, and Kenneth A. Schoeneck *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 327-336 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The design and shop test results are given for a high speed eight stage centrifugal compressor supported by active magnetic bearings. A brief summary of the rotor dynamics analysis is presented with specific attention given to design considerations for optimum rotor stability. The concerns for retrofit of magnetic bearings in existing machinery are discussed with supporting analysis of a four stage centrifugal compressor. Recommendations are given on design and analysis requirements for successful

machinery operation of either retrofit or new design turbomachinery. Author

N86-30187*# Bently Rotor Dynamics Research Corp., Minden, Nev.
ROTOR INTERNAL FRICTION INSTABILITY
Donald E. Bently and Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 337-348 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Two aspects of internal friction affecting stability of rotating machines are discussed. The first role of internal friction consists of decreasing the level of effective damping during rotor subsynchronous and backward precessional vibrations caused by some other instability mechanisms. The second role of internal frication consists of creating rotor instability, i.e., causing self-excited subsynchronous vibrations. Experimental test results document both of these aspects. Author

N86-30188*# Agrico Chemical Co., Donaldsonville, La.
TOPPING TURBINE (103-JAT) ROTOR INSTABILITY IN 1150-STPD KELLOGG AMMONIA PLANTS
Richard Thomas *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 349-359 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

In two of Agrico's three plants, instabilities in the rotor/bearing system have been an ongoing problem. On occasion plant rates, i.e., machine speed, have been restricted in order to limit the exhaust and shaft relative vibration on the 103-JAT to a maximum value of 89 micrometer (0.0035) peak to peak. The purpose is to acquaint one with Agrico's experiences with exhaust end vibration and rotor instabilities on the 103-JAT topping turbine. The final conclusions arrived at were based on: (1) field acquired data both during steady state and transient conditions; (2) computer modeling of the rotor/bearing system; and (3) vibration data taken from a control rotor during a series of test runs in a high speed balancing machine from 0 to 110% of operating speed. Author

N86-30189*# Bently Rotor Dynamics Research Corp., Minden, Nev.
HYDRAULIC INDUCED INSTABILITY ON A VERTICAL SERVICE
R. F. Bosmans *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 361-368 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The case history contained provides insight toward the mechanical and hydraulic behavior of a vertical pump. It clearly demonstrates the need for measurements on the rotor at or near the impeller area. The results are reported of an analysis on a service water pump. This pump is typical of the water pumps used throughout the power generation industry. Although little is known of the mechanical behavior of vertical pumps because of difficulty in modeling the rotor system, recent developments in the application of submersible proximity transducers have made possible the measurement of pump dynamics under operating conditions. The purpose of this study was to determine the proper selection and installation of vibration-monitoring transducers as well as to measure the effects of imbalance, misalignment, and hydraulics on the performance and reliability of vertical pumps. In addition, the cause of shaft failures on this pump was to be determined. Author

N86-30190*# Machinery Diagnostics, Inc., Minden, Nev.
AERODYNAMIC INSTABILITY: A CASE HISTORY
Robert C. Eisenmann *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 369-377 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The identification, diagnosis, and final correction of complex machinery malfunctions typically require the correlation of many parameters such as mechanical construction, process influence, maintenance history, and vibration response characteristics. The progression is reviewed of field testing, diagnosis, and final correction of a specific machinery instability problem. The case history presented addresses a unique low frequency instability problem on a high pressure barrel compressor. The malfunction was eventually diagnosed as a fluidic mechanism that manifested as an aerodynamic disturbance to the rotor assembly. Author

N86-30191*# Technische Univ., Darmstadt (West Germany).
REMARKS ON ROTOR STABILITY (A CONTRIBUTION TO DISCUSSION DURING SYMPOSIUM ON INSTABILITY IN ROTATING MACHINERY)
E. Kraemer *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 379-383 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Influence of nonlinear factors in fluid lubricated bearings on rotor vibrations is discussed as are computation of threshold of stability for systems with multiple degrees of freedom. The reason for this investigation was to learn more about the influence of tilting pad bearings on vertical rotors. The eigenvalues, the stability threshold, the response on the Heaviside-function and the unbalance response were calculated for a rigid rotor, a Jeffcott rotor and for the finite element model of a real rotor. The comparison of the linear and nonlinear calculations shows the limit of the linear calculations. The computation is supposed to show, that the model of the Jeffcott rotor is not sufficient in most practical cases to determine the stability threshold. This was known for some years, when computed results were compared with the behavior of real machines. That's why a program was developed, which is roughly described. E.R.

N86-30192*# Polish Academy of Sciences, Gdansk.
EIGENVALUES AND STABILITY PROBLEMS OF ROTORS
Zbigniew Walczyk *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 385-397 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The essential theoretical results of the application of a developed transfer matrix method to the free transverse vibration of a rotor are shown. Gyroscopic and shear effects, rotary inertia, and external and internal damping as well as the influence of sleeve bearings and rotor supports are taken into consideration. The eigenvalues of the motion equations of the rotor are searched by using a modified determinant method. Author

N86-30193*# Technische Univ., Vienna (Austria).
CHANGES OF INSTABILITY THRESHOLDS OF ROTOR DUE TO BEARING MISALIGNMENTS
Helmut Springer, Horst Ecker, and Edgar J. Gunter (Virginia Univ., Charlottesville.) *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 399-408 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The influence of bearing misalignment upon the dynamic characteristics of statistically indeterminant rotor bearing systems is investigated. Both bearing loads and stability speed limits of a rotor may be changed significantly by magnitude and direction of bearing misalignment. The useful theory of short journal bearings is introduced and simple analytical expressions, governing the misalignment problem, are carried out. Polar plots for the bearing load capacities and stability maps, describing the speed limit in terms of misalignment, are presented. These plots can be used by the designer to estimate deviations between calculation and experimental data due to misalignment effects. Author

N86-30194*# Bently Rotor Dynamics Research Corp., Minden, Nev.
DEMONSTRATION OF VARIOUS ROTOR INSTABILITIES (EXHIBIT OF BENTLY ROTOR DYNAMICS RESEARCH CORPORATION LABORATOR RIGS AT SYMPOSIUM ON INSTABILITY IN ROTAING MACHINERY)
Agnes Muszynska *In* NASA. Lewis Research Center Instability in

Rotating Machinery Dec. 1985 p 409-413 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The operation of rotor rigs used to demonstrate various instability phenomena occurring in rotating machines is described. The instability phenomena demonstrated included oil whirl/whip antiswirl, rub, loose rotating parts, water-lubricated bearing instabilities, and cracked shaft. The rotor rigs were also used to show corrective measures for preventing instabilities. Vibrational response data from the rigs were taken with modern, computerized instrumentation. The rotor nonsynchronous perturbation rig demonstrated modal identification techniques for rotor/bearing systems. Computer-aided data acquisition and presentation, using the dynamic stiffness method, makes it possible to identify rotor and bearing parameters for low modes. The shaft mode demonstrator presented the amplified modal shape line of the shaft excited by inertia forces of unbalance (synchronous perturbation). The first three bending modes of the shaft can be demonstrated. The user-friendly software, Orbits, presented a simulation of rotor precessional motion that is characteristic of various instability phenomena. The data presentation demonstration used data measured on a turbine driven compressor train as an example of how computer aided data acquisition and presentation assists in identifying rotating machine malfunctions. Author

N86-30195*# Bently Nevada Corp., Minden.
WHIRL/WHIP DEMONSTRATION
Robert Grissom *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 415-422 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Fluid flow in bearings and seals, set in motion by shaft rotation, generates dynamic forces which may result in a well recognized instability known as whirl and whip. These are lateral, forward precessional, self excited, subsynchronous vibrations in which the amplitude may vary from very small to nearly the limit of the bearing or seal clearances. Oil whirl in lubricated bearings, in particular, typically occurs at somewhat less than half rotative speed. As the rotative speed increases, the frequency relationship remains constant until the whirl frequency approaches the first balance resonance. Now the whirl is smoothly replaced by whip at a nearly constant frequency asymptotically approaching first balance resonance, independent of increasing rotative speed. Changes in bearing/seal radial loading can permit, prevent, or eliminate this instability. The oil whirl/whip rig demonstrates the effects of fluid dynamic forces generated by the rotating shaft. At low rotative speeds, this produces changes of the journal static equilibrium position within the bearing. The demonstrator shows the relationship between any load direction and the average journal equilibrium position. At higher rotative speeds, the instability threshold is observed as a function of unidirectional radial load, unbalance, and rotor configuration. Author

N86-30196*# Bently Rotor Dynamics Research Corp., Minden, Nev.
ANTI-SWIRLING DEMONSTRATION
Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Maching Dec. 1985 p 423-426 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Fluid in bearings and seals, involved in motion due to shaft rotation and generating fluid dynamic forces, represents the well recognized source of instability known as whirl and whip. It is characterized by shaft forward circular precession at subsynchronous frequency. Control of the flow pattern in the bearing/seal clearance may enhance the stability. The rotor system demonstrates the dynamic effect of perturbation of the flow pattern in a seal gap by blowing compressed air in the rotor tangential direction. This effect results in shifting the rotor threshold of stability to a higher value of rotative speed when the air jet direction opposes rotation, and to a lower value of rotative speed when the air jet direction coincides with rotation. This effect implies that an unstable rotor can be stabilized by blowing air in the direction opposite to rotation. This technique is known as anti-swirl. Author

N86-30197*# Bently Nevada Corp., Minden.
PARTIAL ROTOR-TO-STATOR RUB DEMONSTRATION
Robert Grissom *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 427-430 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

A rotor radial rub typically occurs in seals or at a blade tip or shroud when there is insufficient clearance, high vibration, or the shaft equilibrium position has been displaced to effectively limit the clearance (eccentricity). There are two extreme cases of radial rubs: full annular rub, when the rotor maintains continuous contact with the seal, etc.; and a partial rub, when the contact occurs during a fraction of the precession period. They both involve similar physical phenomena such as friction and modification of stiffness. In partial rubs with consecutive impacts, a significant average value of radial force is generated. This results in shaft average displacement in the direction opposite the rub location. The rotor rig demonstrates the characteristics of a partial lateral rub of varying severity and location. These characteristics include: (1) subharmonic components as a function of rotative speed/first balance resonance ratio and radial force; (2) higher harmonic content as a function of severity; (3) increased average rotor stiffness resulting in increased first balance resonance speed; and (4) change in overall orbital pattern as a sum of the unbalance response (1x) and subharmonic response (1nx). Author

N86-30198*# Bently Rotor Dynamics Research Corp., Minden, Nev.
ROTOR INSTABILITY DUE TO LOOSE ROTATING PART
Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 431-437 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Loosening of a rotating part from its fixed position on the shaft or a part of the stator which comes loose and begins to turn with the rotor very frequently represents machinery malfunction. The loose part becomes involved in rotative motion mostly due to dry or fluid friction, and thus its motion is very erratic. The loose part can also move axially along the shaft. Detachment of the rotating part causes changes in the rotor balance state. Most often this results in higher unbalance. During steady-state operation the effect of a loose rotating part can manifest itself through heat vibration. It can be diagnosed by observing periodic changes of amplitude and phase of the synchronous response. During start-up (or shutdown) a loose rotating part carrying some amount of unbalance may manifest its dynamic action in the form of subsynchronous vibrations, very similar to those of other instabilities. The objective of this demonstration is to observe the effect of a loose rotating part (fixed, however, in the axial direction) under both steady-state (rotor constant speed) and transient (rotor start-up or shutdown) operation. The dynamic response depends very much on the amount of damping in the system: lubrication of the loose part/shaft surfaces and addition/elimination of aerodynamic drag blades, mounted on the loose disk, significantly change the rotor response. Author

N86-30199*# Bently Rotor Dynamics Research Corp., Minden, Nev.
INSTABILITY IN HYDRAULIC MACHINES DEMONSTRATION RIG
Agnes Muszynska and M. J. Braun (Akron Univ., Ohio.) *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 439-442 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

In fluid flow machines, the working fluid involved in rotative motion due to shaft rotation significantly modifies the rotor synchronous response. This can result in the rotor maintaining the high vibration amplitude that occurs at resonance over an extended rotative speed range. The phase changes in this range are typically very small. The fluid may also create rotor instability,

i.e., subsynchronous self-excited vibrations, when the rotative speed is sufficiently high. This rotor instability is often related and increases with higher rotor unbalance (Opposite to other types of instability such as oil whirl/whip, internal friction, etc.). The rotor rig demonstrates typical dynamic behavior of hydraulic machines. At lower speeds the effect of amplitude/phase mentioned above is noticeable; at higher speeds the subsynchronous instability occurs. Author

N86-30200*# Bently Rotor Dynamics Research Corp., Minden, Nev.
CRACKED ROTOR DEMONSTRATION
R. F. Bosmans *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 443-446 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The purpose of this demonstration is to observe the behavior of a rotor with a single crack. This will be presented in oscilloscope orbits, 2X POLAR PLOTS, and spectrum cascade diagrams. Crack detection must be observed in all three formats and monitored over a period of time or start-ups. The change in the 2X behavior pattern provides an early warning that a crack potentially exists and that it is likely propagating toward total rotor fracture. Author

N86-30201*# Bently Rotor Dynamics Research Corp., Minden, Nev.
ROTOR/BEARING SYSTEM DYNAMIC STIFFNESS MEASUREMENTS
Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 447-456 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Sweep perturbation testing as used in Modal Analysis when applied to a rotating machine has to take into consideration the machine dynamic state of equilibrium at its operational rotative speed. This stands in contrasts to a static equilibrium of nonrotating structures. The rotational energy has a significant influence on rotor dynamic characteristics. The best perturbing input for rotating machines is a forward or reverse rotating, circular force applied directly to the shaft. Determination of Dynamic Stiffness Characteristics of the rotor bearing system by nonsynchronous perturbation of a symmetric rotating shaft supported in one relatively rigid and one oil lubricated bearing. Author

N86-30202*# Bently Nevada Corp., Minden.
SHAFT MODE SHAPE DEMONSTRATION
Robert Grissom *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 457-458 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

The dynamic response of a rotating machine is directly influenced by its geometric configuration and all aspects of the rotor construction. These determine two significant parameters, mass distribution and stiffness, which yield a spectrum of natural frequencies and mode shapes. The mode shapes can be presented as snapshots of the characteristic amplitude/phase reponse patterns of the shaft, due to the major forcing function of unbalance, at different rotative speeds. To demonstrate the three shaft mode shapes of the rotor rig using the Shaft Mode Demonstrator and oscilloscopes. The synchronous (1X) amplitude and phase of the rotor vibration in the vertical direction from several points along the shaft is displayed on corresponding points of the demonstrator. Unfiltered vibration from vertical and horizontal probe pairs is displayed on the oscilloscopes in orbit format for a dynamic presentation of the mode shape. Author

N86-30203*# Bently Rotor Dynamics Research Corp., Minden, Nev.
ORBITS: COMPUTER SIMULATION
Agnes Muszynska *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 459-464 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

In rotating machinery dynamics an orbit (Lissajous curve) represents the dynamic path of the shaft centerline motion during shaft rotation and resulting precession. The orbit can be observed with an oscilloscope connected to XY promixity probes. The orbits can also be simulated by a computer. The software for HP computer simulates orbits for two cases: (1) Symmetric orbit with four frequency components with different radial amplitudes and relative phase angles; and (2) Nonsymmetric orbit with two frequency components with two different vertical/horizontal amplitudes and two different relative phase angles. Each orbit carries a Keyphasor mark (one-per-turn reference). The frequencies, amplitudes, and phase angles, as well as number of time steps for orbit computation, have to be chosen and introduced to the computer by the user. The orbit graphs can be observed on the computer screen. Author

N86-30204*# Bently Rotor Dynamics Research Corp., Minden, Nev.
DATA PRESENTATION TECHNIQUES FOR ROTATING MACHINERY MALFUNCTION DIAGNOSIS
Thomas Spettel *In* NASA. Lewis Research Center Instability in Rotating Machinery Dec. 1985 p 465-468 (For primary document see N86-30160 21-37)
Avail: NTIS HC A21/MF A01 CSCL 13I

Baseline steady state data is excellent for documentation of vibration signals at normal operating conditions. Assuming that a set of initial data was acquired with the machinery in a good state of repair, any future changes or deterioration in mechanical condition can be easily compared to the baseline information. Often this type of comparison will yield sufficient information for evaluation of the problem. However, many malfunctions require the analysis of transient data in order to identify the malfunction. Steady-state data formats consist of: Time Base Waveform, Orbit, Spectrum. Transient data formats consist of: Polar, Bode, Cascade. Our objective is to demonstrate the use of the above formats to diagnose a machine malfunction. A turbine-driven compressor train is chosen as an example. The machine train outline drawing is shown. Author

N86-30205*# Spectra Research Systems, Inc., Huntsville, Ala.
BEARING TESTER DATA COMPILATION ANALYSIS, AND REPORTING AND BEARING MATH MODELING Monthly Progress Report, Jul.-1986
Joe C. Cody Aug. 1986 21 p
(Contract NAS8-36183)
(NASA-CR-176909; NAS 1.26:176909; SRS/STD-PR-535/21; Rept-5350) Avail: NTIS HC A02/MF A01 CSCL 13I

Integration of heat transfer coefficients, modified to account for local vapor quality, into the 45 mm bearing model has been completed. The model has been evaluated with two flow rates and subcooled and saturated coolant. The evaluation showed that by increasing the flow from 3.6 to 7.0 lbs/sec the average ball temperature was decreased by 102 F, using a coolant temperature of -230 F. The average ball temperature was decreased by 63 F by decreasing the inlet coolant temperature from saturated to -230 F at a flow rate of 7.0 lbs/sec. Since other factors such as friction, cage heating, etc., affect bearing temperatures, the above bearing temperature effects should be considered as trends and not absolute values. The two phase heat transfer modification has been installed in the 57 mm bearing model and the effects on bearing temperatures have been evaluated. The average ball temperature was decreased by 60 F by increasing the flow rate from 4.6 to 9.0 lbs/sec for the subcooled case. By decreasing the inlet coolant temperature from saturation to -24 F, the average ball temperature was decreased 57 F for a flow rate of 9.0 lbs/sec. The technique of relating the two phase heat transfer coefficient to local vapor quality will be applied to the tester model and compared with test data. Author

N86-30206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY STUDY OF A DISCRETE BEARING/ROLLER DRIVE ROTARY JOINT FOR THE SPACE STATION
Stuart H. Loewenthal and Fredrick T. Schuller Jul. 1986 43 p

(NASA-TM-88800; E-3138; NAS 1.15:88800) Avail: NTIS HC A03/MF A01 CSCL 13I

The most critical mechanism on board the proposed space station is the continously rotating joint which must accurately align the solar power units with the sun during earth orbit. The feasibility of a multiple, discrete bearing supported joint driven by a self-loading, pinch drive actuator was investigated for this application. This concept appears to offer greater protection against catastrophic jamming, less sensitivity to adverse thermal gradients, greater accessibility to inorbit servicing or replacement and greater adaptability to very large (5 m) truss members than to more conventional continuous support bearing/gear reducer joints. Analytical trade studies performed herein establish that a discrete cam roller bearing support system having eight hangers around a continuous ring would provide sufficient radial and bending stiffness to prevent any degradation in the fundamental frequencies of the solar wing structure. Furthermore, it appears that the pinch roller drive mechanism can be readily sized to meet or exceed system performance and service life requirements. Wear life estimates based on experimental data for a steel roller coated with an advanced polyimide film show a continuous service life more than two orders of magnitude greater than required for this application. Author

N86-30207# CRC Automatic Welding Co., Houston, Tex.
SUBMERGED ARC WELDING CONTROL VIA ARC SENSING Final Report, 13 Sep. 1985 - 31 Jan. 1986
Milton D. Randall, George E. Cook, and Mark E. Shepard 31 Jan. 1986 178 p
(Contract N00014-85-C-0750)
(AD-A166320; CRCAW-0001AC) Avail: NTIS HC A09/MF A01 CSCL 13/8

The overall objective of this Phase I research was to establish the feasibility of using intelligence gleaned from the electrical arc signals of the submerged arc welding (SAW) process to adaptively control the position and geometry of the weld head relative to the weld joint. By so doing, it was expected that the weld joint could be tracked accurately and that proper fusion into the joint sidewall (and/or adjacent weld beads in a multipass per layer weld) and uniform fill could be adaptively maintained in real time. The limited research effort of the Phase I research program has shown that through-the-arc sensing and control methodology offers excellent promise for the SAW process. Indeed, the results achieved suggest that through-the-arc sensing will be potentially more powerful as a diagnostic and control tool for the SAW process than the other consumable electrode processes, where it has already met with high success. The results of this Phase I research indicates that the SAW process may prove to be the most applicable for through-the-arc methodologies. Therefore, additional Phase 2 research is necessary and very important and is strongly recommended. GRA

N86-30208# Army Missile Command, Redstone Arsenal, Ala. Structures Directorate.
A VISCOELASTIC-DAMAGE SIMULATION MODEL FOR FILAMENT-WOUND PRESSURE VESSELS
Johnny L. Prater May 1985 67 p
(AD-A166389; AD-E950806; AMSMI/RL-85-4-TR) Avail: NTIS HC A04/MF A01 CSCL 13/4

A model to predict the viscoelastic/damage response of a filament-wound composite cylindrical pressure vessel to a proof-test loading is developed. The matrix material of the composite system is assumed to be isotropic and linearly viscoelastic. A damage model is proposed which produces a quadratic relationship between the transverse modulus and the circumferential strains. A nonlinear model results and is solved by iterative solution based on the damage response. The elastic-viscoelastic correspondence principle is used to produce, in the Laplace domain, an associated elastic solution for the circumferential strains. The associated elastic solution is inverted by using the method of collocation to yield the time-dependent circumferential strain. A numerical example to demonstrate the simulation model is included. A proof-test loading of 5.5 MPa is applied for one minute. Results indicate that the damage as modeled reduces the instantaneous failure load from 9.977 MPa to 7.771 MPa, or 22%. The creep that occurs during the constant load phase of the proof-test loading induces a 3.65% increase in the damage. After removal of the proof-test loading, the strain recovers to zero. However, the transverse modulus does not recover. This emphasizes the need to consider the effects of proof-test loading when the in-service load limits are determined. Author (GRA)

N86-30209# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
STEADY AND UNSTEADY AIR FLOW THROUGH AN INTAKE VALVE OF A RECIPROCATING ENGINE
A. F. Bicen, C. Vafidis, and J. H. Whitelaw 1986 9 p
(DE86-005208; DOE/NBM-6005208) Avail: NTIS HC A02/MF A01

An experimental investigation of the air flow through various axisymmetric intake ports of a reciprocating engine is reported. Detailed velocity field measurements obtained by laser Doppler anemometry and for steady and various unsteady flow conditions are presented together with valve discharge coefficients from steady flow tests. The results showed that the flow at the valve exit exhibited four regimes with a 45° seat angle compared to three in the case of a 60° valve. The overall behavior of the 45° valve, however, was found to be generally better. Rounding of the edges of the 45° valve reduced the number of flow regimes to two with marked improvements on discharge coefficient. The flow angle at the valve exit depended less on the flow regime and more on the cylinder confinement, in the absence of which the transition from one regime to another was delayed. The mean flow pattern at the valve exit was found to be insensitive to flow unsteadiness, piston confinement and valve operation and thus could be predicted with reasonable accuracy from steady flow tests. The in-cyclinder flow characteristics were also insensitive to valve operation, but strongly depended on piston interaction, flow unsteadiness and residual effects from the previous cycle. DOE

N86-30210# Allied Bendix Corp., Kansas City, Mo.
REPEATABILITY STUDY OF A 6-AXIS ROBOT
L. L. Brown Jan. 1986 26 p
(Contract DE-AC04-76DP-00613)
(DE86-006417; BDX-613-3342) Avail: NTIS HC A03/MF A01

Two tests were performed with a six-axis anthropomorphic type robot to evaluate its short-term repeatability and its drift characteristics. One test was taken with the robot mounted on a wood particle base plate; the second was taken with the robot mounted on a metal base plate. Once the robot was past an initial warm-up period, good repeatability characteristics with no significant drift were shown by the robot when it was mounted on a metal base plate. The robot mounted on the wood base plate showed significant drift from the predefined test point. DOE

N86-30211# Rockwell International Corp., Golden, Colo.
A 1000 AMP AC/DC CURRENT SOURCE FOR THE CALIBRATION OF WELDING SYSTEMS
1986 9 p Presented at the IEEE Conference on Instrumentation and Measurements, Boulder, Colo., 25 Mar. 1986
(Contract DE-AC04-76DP-03533)
(DE86-004924; RFP-3872; CONF-860354-3) Avail: NTIS HC A02/MF A01

Calibration of welding systems and parameter monitoring data acquisition systems (DAS) assures transfer of identical welds between similar welders as well as assuring continued quality control of the welding process. A 1000 amp ac/dc current source was developed to aid in the calibration of these welding systems. The equipment used to create the current source is discussed. Engineering data is presented on the performance of the current source to date. The proposed technique for traceability to the National Bureau of Standards (NBS) is given. Test results of current sensors tested are presented and how these results will influence future tests are discussed. Future work is discussed for extending

the current source's accuracy and phase capability for the current source are discussed. DOE

N86-30212# California Univ., Berkeley. Lawrence Berkeley Lab.
CRYOGENIC MECHANICAL PROPERTIES OF HIGH-MANGANESE STEEL WELDMENTS
J. W. Chan and J. W. Morris, Jr. Aug. 1985 11 p Presented at the Cryogenic Engineering Conference and International Cryogenic Materials Conference, Boston, Mass., 12 Aug. 1985
(Contract DE-AC03-76SF-00098)
(DE86-005219; LBL-19226; CONF-850814-37) Avail: NTIS HC A02/MF A01

The structural alloys used in fusion reactor magnets of the next generation are required to have a 4.2 K yield strength and fracture toughness combination superior to that of alloys used currently. An alloy of nominal composition 18Mn-5Ni-16Cr-0.22N after proper thermomechanical treatment approaches the JAERI projected requirements and exceeds the proposed US requirements for 4.2 K yield strength and fracture toughness in the base metal. However, the properties in the welded condition are still uncertain. This work investigates the effect of autogenous GTAW on the cryogenic properties of this alloy. It was found that the 4.2 K yield strength of the weld can be increased through the addition of nitrogen to a 75% He/25% Ar shield gas; specifically, a yield strength comparable to that of the base metal was achieved for a 6 vol % nitrogen addition. Fracture toughness data are still preliminary; however, autogenous welds made on this alloy approach the US requirements for both yield strength and K/sub Ic/. DOE

N86-30213# Ad-Ex Translations International/USA, Menlo Park, Calif.
CUTTING OF METAL COMPONENTS BY INTERGRANULAR CRACKING
J. Chavand (Commissariat a l'Energie Atomique, Grenoble, France), A. Gauthier, J. J. Lopez, and G. Tanis 20 Nov. 1985 86 p Transl. into ENGLISH from "Decoupe de Composants Mettalique, part Fissuration Intergranulaire" (France) Prepared for Pacific Northwest Labs., Richland, Wash.
(Contract DE-AC06-76RL-01830)
(DE86-006949; PNL-TR-454) Avail: NTIS HC A05/MF A01

The objective of this contract was to study a new steel-sheet cutting technique for dismantling nuclear installations without in principle producing secondary waste. This technique is based on intergranular cracking of steel induced by the combined action of penetration of molten metal into the steel and application of a mechanical load. Cutting has been achieved for stainless-steel sheets with thicknesses ranging from a few mm to 50 mm and for carbon-steel plates with thicknesses between 20 and 60 mm. For carbon steel is seems possible that components as thick as 100 mm can be cut. The tests have permitted selection of the heating methods and determination of the cracking parameters for the materials and range of thickness studied. In the case of thin sheets, results were obtained for cutting in varied positions suited to the techniques of dismantling in hot cells. A temperature-measuring system using an infrared camera has been developed to determine the variation of the temperature field established in the component. In association with the three-dimensional computation code COCO developed by the CEA, this system permits prediction of the changes in stresses in the cracked zone when the cutting parameters are modified. DOE

N86-30214# California Univ., Berkeley.
MECHAN: DYNAMIC ANALYSIS OF PLANAR MECHANISMS
Charles W. Radcliffe 1 Jul. 1985 70 p
(Contract W-7405-eng-48)
(DE85-018023; UCID-30200-83-11) Avail: NTIS HC A04/MF A01

The kinematic and dynamic analysis of many common planar mechanisms can be accomplished as a sequence of subproblems where each subproblem involves the analysis of a standard component. These standard components typically involve two rigid bodies and three points of connection between the bodies themselves and or other components which make up the complete mechanism. MECHAN is an interactive computer program for the kinematic and dynamic analysis of planar mechanisms. The program is written in Microsoft Basic (MS-Basic) and will run under either the CP/M or MS DOS operating system. MECHAN allows the user to interactively define the complete mechanism as a series of standard components, specify the input motion parameters, and begin either a kinematic or dynamic analysis of the mechanism. In addition to the analysis of the primary sequence of components, the program allows the specification of arbitrary points attached to any of the moving rigid bodies and the calculation of their position, velocity, and acceleration for each position of the input member. The input member can be specified as a rotating crank, a slider moving in an arbitrary direction, or a crank driven by a linear actuator such as a hydraulic cylinder. The output of the program is in the form of a series of tables which display the angular motion of each rigid body in the mechanism, the linear motion components for each point which has been identified, the relative sliding motion at each slider, and the force components at each joint where members are connected. The force analysis can include the effect of springs or viscous dampers acting between arbitrary pairs of points on separate members. Author

N86-30215# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
COMPOSITE TURBINE BLADE DESIGN OPTIONS FOR CLAUDE (OPEN) CYCLE OTEC POWER SYSTEMS
T. R. Penney Nov. 1985 7 p Presented at the 5th International Symposium and Exhibit on OMAE, Tokyo, Japan, 13 Apr. 1986
(Contract DE-AC02-83CH-10093)
(DE85-016876; SERI/TP-252-2792; CONF-860491-1) Avail: NTIS HC A02/MF A01

Small-scale turbine rotors made from composites offer several technical advantages for a Claude (open) cycle ocean thermal energy conversion (OTEC) power system. Westinghouse Electric Corporation has designed a composite turbine rotor/disk using state-of-the-art analysis methods for large-scale (100-MW sub e) open cycle OTEC applications. Near-term demonstrations using conventional low-pressure turbine blade shapes with composite material would achieve feasibility and modern credibility of the open cycle OTEC power system. Application of composite blades for low-pressure turbo-machinery potentially improves the reliability of conventional metal blades affected by stress corrosion. DOE

N86-30216# Ingersoll-Rand Research, Inc., Princeton, N.J.
SYN-FUEL RECIPROCATING CHARGE PUMP IMPROVEMENT PROGRAM Quarterly Report, Jan. 1 - 31 Mar. 1985
1985 13 p
(Contract DE-AC22-82PC-50033)
(DE86-007482; DOE/PC-50033/T11) Avail: NTIS HC A02/MF A01

Two floating piston seals have been tested in the Ingersoll-Rand Standard Pump Div. Model No. 3V3 triplex reciprocating pump which was special built for this development program. The third leg of the pump was operated in the conventional mode to service as a baseline wear rate. The pump operated in a 110 mesh sand-water slurry at 150 rev. per minute with a plunger stroke of 3 inches and a piston stroke of 1.42 inches. This duplicated the intended piston speed and stroke of the Cattettsburg 7V3 reciprocating charge pump. However, the plunger stroke is unavoidably low, it should be seven inches to match the Catletts-burg pump. The pistons were flushed at the rate of 0.5%, The pump was operated for 200 hours. The flush liquid to the pump was interrupted for several hours because of a drive belt failure. However, even with that problem, based on the observed wear rates during these tests, both seals should have a life in sand of approximately 500 to 550 hours. The wear rate in sand indicates that both seals would have a life in a coal slurry which would exceed two to four thousand hours. Both seals maintained a clean volume of liquid between the piston and the plunger/packing area throughout the tests. There was no change in operating characteristics during the 200 hour tests with both pistons. The conventional leg failed twice during the tests, requiring replacement of packing, plunger, and throat bushing. DOE

N86-30217# New Energy Development Organization, Tokyo (Japan).
DEVELOPMENT OF STIRLING ENGINE IN FY 1984
Aug. 1985 33 p
(DE86-900207; NP-6900207) Avail: NTIS (US Sales Only) HC A03/MF A01

Four engine types utilizing the Stirling cycle are studied. The engines include: a 3 kW displacer, a 3 kW two-piston, a 30 kW swash plate, and a 30 kW double-crank engine. The engines were developed for use in air conditioners and electric generators. DOE

N86-30218# Oak Ridge National Lab., Tenn.
ROBOTICS APPLICATIONS ON AN ADVANCED HYPERCUBE MULTIPROCESSOR: INITIAL DEVELOPMENTS
J. Barhen, M. C. G. Hall, and J. R. Einstein 1986 8 p Presented at the IEEE International Conference on Robotics and Automation, San Francisco, Calif., 14 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-008237; CONF-860434-7) Avail: NTIS HC A02/MF A01

Specialized computer architectures for advanced robotics applications at ORNL/CESAR are based on the hypercube ensemble concept. We summarize the current status of algorithm development and present results for robot dynamics and navigation problems. DOE

N86-30219# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Struct
PRELIMINARY INSTRUMENTATION FOR AEROELASTIC TESTS AT THE COMPRESSOR LEVEL Final Report [INSTRUMENTATION PRELIMINAIRE AUX ESSAIS AEROELASTIQUES AU BANC COMPRESSEUR]
I. Cafarelli Dec. 1985 15 p In FRENCH
(Contract SNECMA-265.806-VY)
(ONERA-RT-95/7108-RY-054-R; ESA-86-97274) Avail: NTIS HC A02/MF A01

Unsteady pressure characterization methods are presented. The instrumentation of the blades before being assembled is described, including the unsteady sensors and an interface printed circuit. The assembling procedures and supplementary precautions such as protective painting are also discussed. ESA

N86-30220# Battelle Columbus Labs., Ohio.
BACKGROUND REVIEW ON COMPRESSORS FOR GAS ENGINE-DRIVEN HEAT PUMPS Task Technical Report, Sep. 1985 - Mar. 1986
R. L. Hall and J. C. Swain Apr. 1986 94 p
(Contract GRI-5084-242-1118)
(PB86-201175; N-4577-0401; GRI-86/0084) Avail: NTIS HC A05/MF A01 CSCL 13A

The efficiency and durability of various types of open shaft compressors for potential application to residential and light commercial gas engine-driven heat pump applications are examined. Variable speed efficiency data for hermetic, semihermetic, and open shaft compressors were obtained from the public literature and from compressor manufacturers in the U. S., Japan, and in Europe. Efficiency comparisons based upon refrigerants R12 and R22 at a fixed compressor pressure ratio indicate that reciprocating compressors have the highest coefficients of performance (COPs) for compressor speeds ranging from 1000 to 2500 rpm. Scroll and Wankel compressors appear to offer the highest COPs above 2500 rpm. An important finding is that open shaft compressors with proven life and reliability for residential gas engine heat pump applications do not appear to be available as production units. GRA

N86-29854# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
INFLUENCE AND TIP CLEARANCE MEASUREMENT IN TURBOMACHINES
Jacques Paulon *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 8 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29855# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
SIMULATION OF FLOW AND HEAT TRANSFER IN ANNULAR CAVITIES BETWEEN DISKS IN TURBOMACHINERY
Denis Dutoya *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

N86-29858# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).
CERAMIC HEAT EXCHANGERS FOR GAS TURBINES OR TURBOJET ENGINES
Serge Boudigues and Jean Fabri *In* AGARD Heat Transfer and Cooling in Gas Turbines Sep. 1985 14 p In FRENCH; ENGLISH summary (For primary document see N86-29823 21-07)
Avail: NTIS HC A23/MF A01

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N86-30221 British Library Lending Div., Boston Spa (England).
USE OF ACOUSTIC EMISSION IN STUDY OF DEFECTS IN BUTT WELD DURING COOLING
V. I. Petrov, G. T. Kortovin, and N. A. Chelyshev 1985 5 p Transl. into ENGLISH from Izv. VUZ Chernaya Metall. (USSR), no. 10, 1985 p 151-152
(BLL-M-36732-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

The use of acoustic emission during cooling of butt-welded articles such as drills, milling cutters etc. to assess the soundness of the joint was studied on specimens 16-30 mm in diameter made up of a carbon-steel part up to 300 mm and a high-speed-cutting steel part up to 90 mm long. The butt-welded joint was sound in some and defective in other specimens. Author

N86-30222 British Library Lending Div., Boston Spa (England).
INDUSTRIAL INSPECTION OF GRAIN SIZE OF PRECISION TUBES AFTER HEAT TREATMENT
V. I. Frolova and P. P. Gusev 1985 4 p Transl. into ENGLISH from Stal (USSR), no. 11, 1985 p 55
(BLL-M-36744-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

A special immersion bath has been developed for ultrasonic inspection of the grain size of precision tubes by the echo-pulse method directly after heat treatment. A brief outline of this process is given. Such inspection permits in-line adjustment of heat treatment schedules to be carried out. Author

N86-30223# Los Alamos National Lab., N. Mex.
APPLICATION OF SYSTEMS ANALYSIS TECHNIQUES TO VULNERABILITY STUDIES OF COMPLEX INSTALLATIONS
T. F. Bott 1986 7 p Presented at the 9th Advances in Reliability Technology Symposium, London, Engl., 1 Apr. 1986
(Contract W-7405-eng-36)
(DE86-006012; LA-UR-86-119; CONF-8604111-1) Avail: NTIS HC A02/MF A01

Application of reliability and risk analysis methods (particularly fault trees) to failure analysis of systems in hostile manmade environments is discussed. Methods for constructing, analyzing, and interpreting the fault trees, graphs, and diagrams are described. The application of fault-trees, directed graphs, and functional diagrams to problems in sabotage, survivability, and information protection is discussed in general terms. Special problems

encountered in this type of analysis are discussed, and future research directions are considered. DOE

N86-30224# Oak Ridge Y-12 Plant, Tenn.
ULTRASONIC ANALYSIS OF THIN ADHESIVE BONDS
C. A. Pickett Jul. 1985 9 p Presented at the Review of Progress in Quantitative NDE, Williamsburg, Va., 23 Jun. 1985
(Contract DE-AC05-84OS-21400)
(DE86-006515; Y/DW-580; CONF-8506110-7) Avail: NTIS HC A02/MF A01

An investigation is reported whose purpose was to determine the cause of amplitude variation that occurs during the ultrasonic inspection of very thin adhesive bonds. Results indicate that the metal-adhesive-metal package behaves like a narrow bandpass filter for signals in the ultrasonic domain. This effect is attributed to a mechanical resonance resulting from material thicknesses and acoustic impedances, and its effects on ultrasonic inspection are discussed. Further work is planned in determining the adhesive thickness of thin bonds ultrasonically and in extending inspection capabilities to include larger thickness range. DOE

N86-30225# Mound Lab., Miamisburg, Ohio.
STRENGTH CHARACTERIZATION METHOD FOR EVALUATING CERAMIC-TO-METAL BONDS
D. L. Sheppard 14 Feb. 1986 11 p
(Contract DE-AC04-76DP-00053)
(DE86-007526; MLM-3336) Avail: NTIS HC A02/MF A01

A quick and reliable method has been devised for characterizing bond strengths of cylindrically shaped ceramic-to-metal structures. The method uses simplified geometry to evaluate the contribution of bond strength to the overall strength of ceramic-to-metal structures. Data show that strength differences resulting from process variations can be measured through this straightforward technique. DOE

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N86-30226 British Library Lending Div., Boston Spa (England).
CALCULATING THE TEMPERATURE AND STRESSES WHEN ONE SIDE OF A PLATE IS HEATED WITH A CONSTANT FLOW OF HEAT
V. M. Guba and Yu. S. Postolnik 1986 8 p Transl. into ENGLISH from Iz. (USSR), p 119-122
(BLL-M-36723-(5828.4)) Avail: British Library Lending Div., Boston Spa, England

A mathematical procedure based on earlier work is given for determining the temperature and stress fields in plates, one of the surfaces of which is heated by a constant flow of heat and the other by convection from the ambient atmosphere. A model is used, and approximate analytical relationships are obtained for calculating the temperature and stresses in plates. The procedure is applied to free plates and plates rigidly held. Author

N86-30227*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
INTEGRATED RESEARCH IN CONSTITUTIVE MODELLING AT ELEVATED TEMPERATURES, PART 1 Final Report
W. E. Haisler and D. H. Allen Jun. 1986 332 p
(Grant NAG3-491)
(NASA-CR-177237; NAS 1.26:177237; MM-4998-86-13-Pt-1) Avail: NTIS HC A15/MF A01 CSCL 20K

Topics covered include: numerical integration techniques; thermodynamics and internal state variables; experimental lab development; comparison of models at room temperature; comparison of models at elevated temperature; and integrated software development. For individual titles, see N86-30228 through N86-30232.

N86-30228*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
[INTEGRATED RESEARCH IN CONSTITUTIVE MODELLING AT ELEVATED TEMPERATURES: SUMMARY OF THE PROJECT]
W. E. Haisler and D. H. Allen *In its* Integrated Research in Constitutive Modelling at Elevated Temperatures, Part 1 Jun. 1986 37 p (For primary document see N86-30227 21-39)
Avail: NTIS HC A15/MF A01 CSCL 20K

This research centers on evaluation of thermoviscoplastic constitutive models for metals at elevated temperatures. The intent of the research was to improve existing experimental facilities at the research site, to compare existing models to experiment for the materials in question, and to extend existing models where necessary to better predict complex material response. Conclusions of the research to date include the following: (1) Euler's method is the most efficient for integrating the models of methods considered; (2)Walker's model is the most economical to integrate, while Miller's model is least economical and also tends to be unstable; (3) ISV theory can be used as a general framework for comparing all models in the current literature; (4) a laboratory has been developed to perform all of the complicated elevated temperature experiments necessary for the research; (5) for aluminum at room temperature, none of the models considered appears accurate at predicting uniaxial cyclic response; and (6) at 1100 deg F Walker's model appears to be most accurage for predicting the uniaxial cyclic response of IN718. J.P.B.

N86-30229*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
NUMERICAL CONSIDERATIONS IN THE DEVELOPMENT AND IMPLEMENTATION OF CONSTITUTIVE MODELS
W. E. Haisler and P. K. Imbrie *In its* Integrated Research in Constitutive Modelling at Elevated Temperatures, Part 1 Jun. 1986 17 p Previously announced as N85-31541 (For primary document see N86-30227 21-39)
Avail: NTIS HC A15/MF A01 CSCL 20K

Several unified constitutive models were tested in uniaxial form by specifying input strain histories and comparing output stress histories. The purpose of the tests was to evaluate several time integration methods with regard to accuracy, stability, and computational economy. The sensitivity of the models to slight changes in input constants was also investigated. Results are presented for In100 at 1350 F and Hastelloy-X at 1800 F. Author

N86-30230*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
EVALUATION OF THE NUMERICAL STABILITY AND SENSITIVITY OF MATERIAL PARAMETER VARIATIONS FOR SEVERAL UNIFIED CONSTITUTIVE MODELS
P. K. Imbrie, W. E. Haisler, and D. H. Allen *In its* Integrated Research in Constitutive Modelling at Elevated Temperatures, Part 1 Jun. 1986 88 p (For primary document see N86-30227 21-39)
(MM-4998-85-6-Pt-1) Avail: NTIS HC A15/MF A01 CSCL 20K

The sensitivity of unified constitutive theories to numerical integration techniques was investigated. Numerical simulations of Hastelloy-X at 1800 F were evaluated in uniaxial form. Both single and multistep integration schemes were used. The various algorithms were compared with regard to accuracy, stability, and computational economy. The material parameter sensitivity was studied by varying the material constants by a specified amount and comparing predicted responses. Numerical comparisons show that, of the numerical integration methods studied, Eulers method is the most accurate, stable, and efficient procedure. The input sensitivity studies indicated that some constitutive models are more sensitive to experimental errors than others and that a 5% error in certain material constraints may lead to 15 to 30% changes in predicted response. B.G.

N86-30231*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
ON THE USE OF INTERNAL STATE VARIABLES IN THERMO-VISCOPLASTIC CONSTITUTIVE EQUATIONS
D. H. Allen and J. M. Beek *In its* Integrated Research in Constitutive Modelling at Elevated Temperatures, Part 1 Jun. 1986 20 p Previously announced as N85-31536 (For primary document see N86-30227 21-39)
Avail: NTIS HC A15/MF A01 CSCL 20K

The general theory of internal state variables are reviewed to apply it to inelastic metals in use in high temperature environments. In this process, certain constraints and clarifications will be made regarding internal state variables. It is shown that the Helmholtz free energy can be utilized to construct constitutive equations which are appropriate for metallic superalloys. Internal state variables are shown to represent locally averaged measures of dislocation arrangement, dislocation density, and intergranular fracture. The internal state variable model is demonstrated to be a suitable framework for comparison of several currently proposed models for metals and can therefore be used to exhibit history dependence, nonlinearity, and rate as well as temperature sensitivity.
E.A.K.

N86-30232*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
A COMPARISON OF CURRENT MODELS FOR NONLINEAR RATE-DEPENDENT MATERIAL BEHAVIOR OF CRYSTALLINE SOLIDS M.S. Thesis c76
Joachim Michael Beek *In its* Integrated Research in Constitutive Modelling at Elevated Temperatures, Part 1 Jun. 1986 148 p (For primary document see N86-30227 21-39)
Avail: NTIS HC A15/MF A01 CSCL 20K

Three theories for prediction of inelastic deformation which are based on considerations of the microstructural behavior of materials are reviewed. The mechanics of continua with internal state variables and the historical development of constitutive modeling are summarized. A detailed discussion, including chronological development, review of theory, and method of determination of material parameters, of each model follows. An experimental data base is established from which the material parameters of the constitutive equations are calculated. Finally computer simulations of various load histories are performed and compared to the experiment, and conclusions of the ability of each theory to model inelastic deformation are drawn.
B.G.

N86-30233*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TECHNIQUE FOR MEASURING SIDE FORCES ON A BANKED AIRCRAFT WITH A FREE-SWIVELING NOSE GEAR
Sandy M. Stubbs and John A. Tanner Aug. 1986 23 p
(NASA-TM-87719; L-16137; NAS 1.15:87719) Avail: NTIS HC A02/MF A01 CSCL 20K

An experimental investigation was conducted at the Langley Research Center to determine a method for towing an aircraft to measure the side forces of a free-swiveling nose gear due to variations in bank angle. A F-106 aircraft and the Space Shuttle orbiter OV-101 were towed to measure side forces on full-size aircraft for bank angles up to 3 deg. These tests indicate that substantial side forces will occur if an aircraft is rolling on a runway in a banked attitude even when the nose gear is free to swivel. Corotation of a twin-tire nose gear appears to cause a substantial increase in side force due to bank angle compared with a nose gear with indepdendently rotating wheels.
Author

N86-30234*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A SIMPLE NONLINEAR JOINT MODEL
W. B. Fichter Aug. 1986 7 p
(NASA-TM-87749; L-16169; NAS 1.15:87749) Avail: NTIS HC A02/MF A01 CSCL 20K

Hertzian contact theory is applied to a butt joint with specially mismatched bearing surfaces to devise a simple mathematical model of nonlinear axial force-displacement behavior in jointed members. Normalized tangent stiffness-force plots, for several values of a joint imperfection parameter, are presented for the sample case of solid structural members of circular section. The results illustrate the potential problem of high joint compliance at low axial-force levels, as well as the generally desirable stiffening and linearizing effects of preload. A nonlinear oscillator problem based on the static model is also formulated and solved to illustrate the effect of amplitude on natural frequency. As expected, natural frequency is low when amplitude is small. The results call attention to the important roles that tight tolerances and preload are expected to play in the design and fabrication of deployable and erectable truss-type space structures.
Author

N86-30235*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRUCTURES AND DYNAMICS DIVISION RESEARCH AND TECHNOLOGY PLANS FOR FY 1986 AND ACCOMPLISHMENTS FOR FY 1985
Kay S. Bales Jul. 1986 105 p
(NASA-TM-87742; NAS 1.15:87742) Avail: NTIS HC A06/MF A01 CSCL 20K

Presented are the Objectives, FY 1986 Plans, Approach, and FY 1986 Milestones for the Structures and Dynamics Division's research programs. FY 1985 Accomplishments are presented where applicable. This information is useful in program coordination with other governmental organizations in areas of mutual interest.
Author

N86-30236*# Cleveland State Univ., Ohio. Dept. of Civil Engineering.
COMPLIANCE MATRICES FOR CRACKED BODIES Final Report
R. Ballarini Jul. 1986 8 p
(Contract NCC3-46)
(NASA-CR-179478; E-3158; NAS 1.26:179478) Avail: NTIS HC A02/MF A01 CSCL 20K

An algorithm is presented which can be used to develop compliance matrices for cracked bodies. The method relies on the numerical solution of singular integral equations with Cauchy-type kernels and provides an efficient and accurate procedure for relating applied loadings to crack opening displacements. The algorithm should be of interest to those performing repetitive calculations in the analysis of experimental results obtained from fracture specimens.
Author

N86-30237# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
CREEP AND FRACTURE CHARACTERISTICS OF MATERIALS AND STRUCTURES AT ELEVATED TEMPERATURES Technical Progress Report
Harold Liebowitz 14 Feb. 1986 348 p
(Contract N00014-84-K-0027)
(AD-A166575) Avail: NTIS HC A15/MF A01 CSCL 20/11

A major focus of the first year was on the mixed-mode fracture problem. Theoretical work on the computational methodology for the calculation of mixed-mode stress intensity factors was performed. The convergence properties of several algotithms were delineated and guidelines for the accurate calculation of mixed-mode stress intensity factors were established. This study also investigated the effects and influence of loading holes on the calculations. Appendices contained in this report refer to Determination of Two-Dimensional Stress Intensity; Fracture Under Mixed-Mode Loading; Prediction of Plasticity Characteristics for Three-Dimensional Fracture Specimens Comparison With Experiment; Accurate Modeling of Ductile and Creep Fracture Specimens and Processes; Creep Testing and Constitutive modeling; Finite Element Formulation for Creep Problems; Finite Element Methodology for Elastic Fracture Problems in 3-Dimensions.
GRA

N86-30238# Argonne National Lab., Ill.
REVIEW OF FRACTURE PROPERTIES OF NUCLEAR MATERIALS DETERMINED BY HERTZIAN INDENTATION
J. Routbort and H. Matzke 1985 13 p Presented at the

Conference on Indentation Fracture and Mechanical Properties of Ceramic Fuels, Waste Ceramics and Glasses, Karlsruhe, West Germany, 11 Nov. 1985 Prepared in cooperation with Commission of the European Communities, Karlsruhe, West Germany
(Contract W-31-109-eng-38)
(DE86-005520; CONF-8511146-1) Avail: NTIS HC A02/MF A01

A brief description of the determination of the surface fracture energy and the fracture toughness from a Hertzian indentation test is given. A number of theoretical and experimental problems are discussed. Results obtained on a variety of nuclear fuels and nuclear-waste-containment materials are reviewed and compared with values measured by other techniques. The Hertzian indentation test yields reliable fracture parameters. DOE

N86-30239# Stanford Univ., Calif. Div. of Applied Mechanics.
COMPUTATIONAL SIGNIFICANCE OF THE INTERMEDIATE CONFIGURATION AND HYPERELASTIC STRESS RELATIONS IN FINITE DEFORMATION ELASTROPLASTICITY
J. C. Simo, R. L. Taylor, and T. J. R. Hughes Jan. 1986 52 p
(Contract W-7405-eng-48)
(DE86-006720; UCRL-15754) Avail: NTIS HC A04/MF A01

The computational significance of the intermediate configuration and hyperelastic stress relations in finite deformation elastoplasticity is addressed. A fully three-dimensional finite-strain viscoelestic damage model is formulated. The variational foundations of assumed strain methods are discussed. A consistent return mapping algorithm is developed for plane stress elastoplasticity. DOE

N86-30240# Pacific Northwest Lab., Richland, Wash.
FAILURE ANALYSIS AND MICROCRACK DEPENDENT DISCONTINUUM MECHANICS
R. B. Stout Nov. 1985 15 p Presented at the International Conference and Exhibition on Fatigue, Corrosion Cracking, Fracture Mechanic and Failure Analysis, Salt Lake City, Utah, 2 Dec. 1985
(Contract W-7405-eng-48)
(DE86-006710; UCRL-92226; CONF-851203-1) Avail: NTIS HC A02/MF A01

The failure of many materials involves creating dense sets of microcracks. Each microcrack created results in a discontinuity in the deformation between atoms in the material and a change in the thermodynamic energy content of the material. Continuum mechanics does not provide a physical description of the discontinuities nor assign correct internal energy contributions for various thermodynamic processes during microcrack kinetics. In order to represent discontinuities in the deformation and various internal energy contributions during microcrack kinetics, a microcrack dependent discontinuum mechanics has been formulated. This discontinuum mechanics describes a microcrack density function in terms of physical attributes and statistical concepts; represents deformation as a functional to explicitly include interatomic discontinuities from the density of microcrack defects; and models both equilibrium and nonequilibrium thermodynamic processes of microcrack creation, microcrack growth, and microcrack surface energy changes. This contrasts to the empirical methodology of continuum mechanics that seeks a phenomenological description. An illustrative example of the microcrack dependent discontinuum approach is presented for the uniaxial tensile test. This analysis provides realistic representations for microcrack density evolution, local (true) stress response, and loading history for an input of total strain rate. DOE

N86-30241# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Mechanical Engineering.
RESIDUAL STRESS AND DEFORMATION ENERGY UNDER GROUND-SURFACES OF BRITTLE SOLIDS Thesis
O. Podzimek Sep. 1985 114 p
(WB-85-16; ESA-86-97356) Avail: NTIS HC A06/MF A01

Deformation energy accumulated under the surface of brittle solids, especially those of optical glass, during the free abrasive grinding process was analyzed. The distribution of deformation energy density in depth under the ground surface was investigated. A model for the free abrasive grinding process was derived using the deformation energy density experimentally determined in relation to the abrasive size, grinding rate, and input power. The model was validated against a series of relations between process parameters from the literature. ESA

N86-30242# Koninklijke/Shell-Lab., Amsterdam (Netherlands).
INVESTIGATION OF THE EXTENT AND NATURE OF THE CRACKS FOUND IN SEGMENTS OF TWO Cr - 0.5 Mo PRESSURE VESSELS FROM THE NIL RESIDUAL CREEP LIFE PROGRAM
A. Deurhof and P. E. L. B. Rodrigues 22 Jul. 1985 25 p
(MR/814/85; ESA-86-97501) Avail: NTIS HC A02/MF A01

A metallographic investigation was carried out on samples taken from two 1 Cr - 0.5 Mo steel headers, operating at 525 C; 81 N/sqmm; 18,000 hr in a controlled test. A nozzle section from each vessel was examined. Both samples show discontinuous surface breaking cracks and microvoids. This damage could be due to reheat cracking which occurred during post weld heat treatment or due to creep. Micrographically it is not possible to distinguish between these two forms of cracking after the vessel is exposed to high temperature. Weld inplant testing may be a way of establishing the sensitivity of this material to reheat cracking and therefore clarify the cause of failure. ESA

42 GEOSCIENCES (GENERAL)

N86-30243# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
BASIC ELEMENTS OF NUCLEAR GEOPHYSICS
D. J. R. Nordemann and E. B. Pereira 1984 31 p In PORTUGUESE
(DE86-700735; INPE-3002) Avail: NTIS (US Sales Only) HC A03/MF A01

Nuclear Geophysics applies the nuclear radiation detection methodology to the geosciences, specially to study the dynamical processes of the lithosphere, the hydrosphere and the atmosphere as well as some aspects of planetology and astrophysics. Here the main methods are described: alpha-ray and gamma-ray spectrometry, the interaction of alpha and gamma radiation with matter and the detectors used (grid chambers, surface barrier silicon detector for alpha radiation; and sodium iodide thallium activated phosphors, hyp~pure and lithium drifted germanium semiconductor detectors for gamma radiation). The principal applications of Nuclear Geophysics are given as examples to ilustrate the use of the methods described. DOE

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N86-30244# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
VISUAL AERIAL PHOTOGRAPH TESTURE DISCRIMINATION FOR DELINEATING HOMOGENEOUS RESIDENTIAL SEGTORS: AN INSTRUMENT FOR URBAN PLANNERS
Maria doLourdes Neves deOliveiraKurkdjian May 1986 7 p Presented at the International Symposium on Remote Sensing, Enschede, Netherlands, Aug. 1986
(INPE-3896-PRE/938) Avail: NTIS HC A02/MF A01

A method is given for the definition of a geographical reference system to be used by planners in urban residential area analysis. The purpose of the method is to exploit, in the diagnosis, the spatial component of the town which is the concrete result of the interactions between its physical and social elements. The assumptions made are: (1) the urban residential areas in Brazilian

towns are extremely differentiated as a result of the social statification existent in the country; (2) there is a strong association between physical aspects of these areas and the socioeconomic characteristics of their resident population. The method preconizes the use of panchromatic aerial photographs at a scale of 1:10000 for the delimitation of homogeneous residential sectors. The procedures described are based on the human visual capability to descriminate different textures. In order to test its validity, survey data obtained through its application to Sao Jose dos Campos, SP, Brazil, were analysed using cluster analysis technique. The results of the work showed that photointerpretation may be usefully applied for delineating homogeneous residential urban sectors.
Author

N86-30245# Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
A PROCEDURE FOR EVALUATION OF DUST POTENTIAL IN DESERT TERRAINS
Ran Gerson, Sari Grossman, and Rivka Amit 1985 87 p
(Contract DAJA45-83-C-0041)
(AD-A166491) Avail: NTIS HC A05/MF A01 CSCL 08/2

The evaluation of dust potential in hot deserts is based on the association of well defined dust bearing soils and surficial deposits with specific landforms. Thses landforms are readily identified on airphotos (and in many cases on topographic maps and space imagery). The user may follow a sequence of operations, from the selection of a target area through the identification of relevant landforms and associated soils/surficial deposits, to the evaluation of the content, composition and distribution of dust in these media. The accompanying report is essential for the proper use of this procedure. GRA

N86-30246# Army Engineer Topographic Labs., Fort Belvoir, Va.
IMPLEMENTATION OF MAP-TO-IMAGE-CORRESPONDENCE FOR SYNTHETIC APERTURE RADAR IMAGE ANALYSIS
George E. Lukes and J. Hannes Raggam 1985 11 p
(AD-A166791; ETL-R-082) Avail: NTIS HC A02/MF A01 CSCL 08/2

Radargrammetric techniques, developed to support stereo mensuration and data capture from synthetic aperture radar (SAR) imagery, have been extended to enable map-to-image correspondence for computer-assisted radar image analysis. This mechanism projects existing digital map data into the image space of a new SAR image rigorously accounting for the sensor imaging geometry and terrain configuration. Prerequisites for SAR map-to-image correspondence include (1) an analytical sensor model, (2) recovery of the image acquisition parameters and (3) three-dimensional (3d) digital map data. Analytical radar mapping techniques address the first two issues. Suitable 3d planimetric map data can be compiled directly from stereo photography using analytical plotters or indirectly using elevation data interpolated from digital elevation models to augment conventional two-dimensional map data derived from manuscripts. The approach is illustrated by selected examples from a case study conducted for a test area near Frieburg, West Germany. Here, 3d digital data for transportation and landcover maps were assembled from cartographic sources using plan metric augmentation. GRA

N86-30247# Argonne National Lab., Ill.
GEOLOGY AND PETROLEUM RESOURCES OF THE BARENTS-NORTHERN KARA SHELF IN LIGHT OF NEW GEOLOGIC DATA
G. Ulmishek Oct. 1985 93 p
(Contract W-31-109-eng-38)
(DE86-008472; ANL/ES-148) Avail: NTIS HC A05/MF A01

The Barents-northern Kara shelf, one of the largest continental shelves in the world, is still in the earliest stage of exploration for oil and gas. During the last several years, numerous seismic surveys have been conducted, a number of wells have been drilled, and several gas fields have been discovered. This report summarizes the geological data gathered during recent exploration activities and presents the changes in earlier concepts necessitated by consideration of these new data. The revised assessment of undiscovered petroleum resources is based on new information about the distribution and quality of source rocks and reservoir rocks and the structural framework of the shelf. Special attention is paid to evaluating the oil versus gas potential of the shelf, an evaluation that strongly depends on the expected offshore extension of oil-source facies in the Lower-Middle Triassic section. The most probable amounts of undiscovered petroleum resources of the shelf are estimated at 14.2 x 10 to the 9th power barrels of oil and 312.2 x 10 to the 12th power cubic feet of gas. The Finnmark trough, the south Barents and North Novaya Zemlya depressions, and the offshore continuation of the Timan-Pechora basin possess the great majority of these resources. DOE

N86-30248# International Centre for Theoretical Physics, Trieste (Italy).
GEM 10B SATELLITE GRAVITY DATA AND NIGERIAN OIL PROSPECTS
S. C. Garde and W. Y. Kim Nov. 1984 11 p
(DE86-701366; IC-84/202) Avail: NTIS (US Sales Only) HC A02/MF A01

Extension of the hydrocarbon rich Benue depression and the Niger delta basin in the bight of Benin is construed from the gravity data of gravity Earth Model (GEM) 10B Satellite, published by NASA, Goddard Space Flight Center in 1977. This interpretation is based on the supposition that: 1) the depth of a buried horizontal cylinder can be estimated by the Fourier transform of the vertical gravity field; and 2) the oil horizons of southern Nigeria are basically connected to the separation of South American and African plates. DOE

N86-30249# Netherlands Agency for Aerospace Programs, Delft.
REPORT ON THE PHASE A STUDY OF A JOINT INDONESIAN-NETHERLANDS TROPICAL EARTH RESOURCES SATELLITE (TERS) PROGRAM
Mahsun Irsyam, ed. and Albert P. Hoeke, ed. Feb. 1985 45 p
(JTERS-84-10; ESA-86-97498) Avail: NTIS HC A03/MF A01

The baseline of the Tropical Earth Resources Satellite (TERS) System was established. Using the possibilities of the high true equatorial orbit, 4 observation opportunities per day, a coverage area of at least 10 deg N to 10 deg S latitude, and the selective viewing capability combined with a cloud sensor, the TERS concept is an appropriate system to complement and to compete with the conventional systems with optical instruments and planned radar systems. User requirements for TERS as a monitoring device for Indonesia are specified. Results of a cost/benefit assessment indicate expected benefits which for Indonesia alone may justify the investment. The political/legal aspects were assessed and a public information plan was drafted. ESA

N86-30250# Technische Hogeschool, Delft (Netherlands). Dept. of Electrical Engineering.
MICROWAVE REMOTE SENSING AND VEGETATION: PROBLEMS, PROGRESS AND SOLUTIONS, A REVIEW
L. Krul Sep. 1984 8 p
(ESA-86-97556) Avail: NTIS HC A02/MF A01

Two approaches to radar signal processing for remote sensing are reviewed. The first considers the microwave region as just another window to be used in combination with the ones already existing in other wavelength regions. The second tries to solve the problem by fundamental investigations in the interaction between microwaves and remote sensing objects. ESA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N86-30251*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND INITIAL TESTING OF A ONE-BLADED 30-METER-DIAMETER ROTOR ON THE NASA/DOE MOD-O WIND TURBINE Final Report
R. D. Corrigan and C. B. F. Ensworth 1986 19 p Presented at the Energy-Sources Technology Conference Exhibition, New Orleans, La., 23-28 Feb. 1986; sponsored by ASME
(Contract DE-AI01-76ET-20320)
(NASA-TM-88810; E-3162; DOE/NASA-20320/70; NAS 1.15:88810) Avail: NTIS HC A02/MF A01 CSCL 10A

The concept of a one-bladed horizontal-axis wind turbine has been of interest to wind turbine designers for many years. Many designs and economic analyses of one-bladed wind turbines have been undertaken by both United States and European wind energy groups. The analyses indicate significant economic advantages but at the same time, significant dynamic response concerns. In an effort to develop a broad data base on wind turbine design and operations, the NASA Wind Energy Project Office has tested a one-bladed rotor at the NASA/DOE Mod-O Wind Turbine Facility. This is the only known test on an intermediate-sized one-bladed rotor in the United States. The 15.2-meter-radius rotor consists of a tip-controlled blade and a counterweight assembly. A rigorous test series was conducted in the Fall of 1985 to collect data on rotor performance, drive train/generator dynamics, structural dynamics, and structural loads. This report includes background information on one-bladed rotor concepts, and Mod-O one-bladed rotor test configuration, supporting design analysis, the Mod-O one-blade rotor test plan, and preliminary test results. Author

N86-30252# Brookhaven National Lab., Upton, N. Y.
PROCEEDINGS OF THE NINTH DOE SOLAR PHOTOCHEMISTRY RESEARCH CONFERENCE
1985 206 p Conference held at Lake Mohonk, N.Y., 2 Jun. 1985 Prepared in cooperation with Department of Energy, Washington, D.C.
(Contract DE-AC02-76CH-00016)
(DE86-006167; BNL-51890; CONF-8506244) Avail: NTIS HC A10/MF A01

This meeting brought together contractors and grantees of the Division of Chemical Sciences in its basic research program on solar photochemical energy conversion to exchange information and discuss problems of mutual interest. This volume contains the program of the meeting, the abstracts of 28 formal presentations and 42 posters, a record of questions and answers following each presentation, and a list of attendees. DOE

N86-30253# Sandia National Labs., Albuquerque, N. Mex.
DESIGN CONSIDERATIONS FOR STAND-ALONE PHOTOVOLTAIC SYSTEMS
R. N. Chapman 1986 11 p Presented at the 1st International Symposium on Applications of Solar and Renewable Energy, Cairo, Egypt, 23 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-006470; SAND-85-2390C; CONF-860322-1) Avail: NTIS HC A02/MF A01

Long-term availability, defined as the total energy delivered over the lifetime of a system divided by the total energy demand, is a major design criterion for stand-alone photovoltaic systems. Using long-term insolation data from 18 US sites and a newly developed performance model, we found that common sizing practices do not reliably provide desired availability. We developed a new technique that allows the designer to size for a specific long-term availability. This new technique can be used for most climatic types found worldwide and for any stand-alone photovoltaic system. The long-term insolation data and performance model were also used to study the yearly variations in availability. We found that even with systems designed for high long-term availability, there will be periods of very low availability. DOE

N86-30254# Oak Ridge National Lab., Tenn.
APPLICATIONS OF LASER ANNEALING AND LASER-INDUCED DIFFUSION TO PHOTOVOLTAIC CONVERSION
R. F. Wood, R. D. Westbrook, and G. E. Jellison, Jr. 1985 13 p Presented at the Progress Review Meeting of SERI's Advanced High Efficiency Concepts Program, Lakewood, Colo., 12 Sep. 1985
(Contract DE-AC05-84OR-21400)
(DE86-003809; CONF-8509247-1) Avail: NTIS HC A02/MF A01

Recent results of studies of pulsed laser processing of high-efficiency silicon solar cells are reported. Thses studies have focussed on intrinsic and extrinsic surface passivation of cells fabricated by glow-discharge implantation and either furnace annealing or laser annealing. DOE

N86-30255# Purdue Univ., West Lafayette, Ind. School of Electrical Engineering.
HIGH INTENSITY SOLAR CELLS
R. J. Schwartz, J. L. Gray, and M. S. Lundstrom Jan. 1986 88 p
(Contract DE-AC04-76DP-00789)
(DE86-006550; SAND-85-7014) Avail: NTIS HC A05/MF A01

Two computer codes, SCAP1D and SCAP2D, are being used to analyze silicon concentrator solar cells. The models used in these codes are constantly being evaluated for accuracy and are updated as necessary. For example, the effects of carrier-carrier scattering on mobility have been included and documented in this report. In addition, modifications to SCAP2D have been made to allow the modeling of minority carrier reflecting contacts. A semianalytical model was developed and used to estimate the theoretical limit of efficiency of silicon concentrator cells. It is predicted that efficiencies near 30% may be possible at high concentration. Reprints of published papers are included in the appendices. DOE

N86-30256# Spire Corp., Bedford, Mass.
GALLIUM ARSENIDE AND MULTIBANDGAP SOLAR CELL RESEARCH Semiannual Subcontract Report, Apr. - Oct. 1984
S. M. Vernon and R. G. Wolfson Nov. 1985 56 p
(Contract DE-AC02-83CH-10093)
(DE85-016894; SERI/STR-211-2824) Avail: NTIS HC A04/MF A01

This report covers the first six months of research on high-efficiency, low-cost solar cells. The basic approach involved the heteroepitaxial growth of a III-V compound material onto a single-crystal silicon wafer. The growth technique employed was metal-organic chemical vapor deposition (MO-CVD) in an atmospheric pressure reactor. The silicon wafer may be a mechanical substrate and ohmic contact for a single-junction device, or it may contain a p-n junction of its own as the bottom cell of a two-junction, tandem device. The III-V single-junction cell material is GaAs and the two-junction material is either GaAlAs or GaAsP; either material could yield a band gap of about 1.7eV. Single-crystal films of Ge, deposited onto silicon wafers by CVD, are also being studied. DOE

N86-30257# Sandia National Labs., Albuquerque, N. Mex.
WIND TURBINE FATIGUE CONSIDERATIONS
D. Berg 1985 10 p Presented at the IEA Fatigue Experts Meeting, Stuttgart, West Germany, 28 Nov. 1985
(Contract DE-AC04-76DP-00789)
(DE86-006499; SAND-85-2617C; CONF-8511164-1) Avail: NTIS HC A02/MF A01

Current methods of analyzing wind turbine fatigue life are reviewed and found to be inadequate. One reason for this inadequacy is that these methods treat material fatigue properties as well-defined values, when they are, in fact, more accurately described as statistically varying values. Tools for incorporating statistically varying properties into fatigue life analysis exist, and development of improved analysis methods is currently in progress. Easy access to a wind turbine material fatigue characteristics data base and recommended procedures for determining factors of safety would increase the confidence level in fatigue life estimation. DOE

N86-30258# Minnesota Mining and Mfg. Co., St. Paul. Electronic and Information Sector Labs.
RESEARCH ON HIGH-EFFICIENCY, SINGLE-JUNCTION, MONOLITHIC, THIN-FILM AMORPHOUS SILICON SOLAR CELLS Semiannual Subcontract Progress Report, 1 Dec. 1984 - 31 May 1985
G. R. Ashton, F. E. Aspen, R. L. Jacobson, F. R. Jeffrey, and N. T. Tran Jan. 1986 85 p
(Contract DE-AC02-83CH-10093)
(DE86-004420; SERI/STR-211-2861) Avail: NTIS HC A05/MF A01

This report presents interim results of research in high-efficiency, single-junction, monolithic thin-film amorphous silicon solar cells, which consists of five research tasks: (1) amorphous silicon materials research, (2) nonsemiconductor materials research, (3) solar cell research, (4) monolithic, intraconnected cells/submodule research, and (5) multichamber deposition system research. The subcontracted work reported here advances the state of the art in thin-film amorphous silicon solar cell development through work on flexible substrates. A multichamber deposition system for depositing a-Si onto polyimide flexible web is essentially complete. DOE

N86-30259# North Carolina State Univ., Raleigh. Dept. of Materials Engineering.
RAPID THERMAL PROCESSING OF ION IMPLANTED SILICON AS A VIABLE SOLAR CELL TECHNOLOGY Quarterly Report, Nov. 1985 - Jan. 1986
G. A. Rozgonyi 31 Jan. 1986 20 p
(DE86-008216; DOE/JPL-957175/Q3) Avail: NTIS HC A02/MF A01

The main objective of the past quarter was to find the optimal pre-process heat treatment for enhancing minority carrier lifetime. The silicon substrates were both n- and p-type and had varied oxygen concentration and process induced defects. Pre-process heat treatments include traditional furnace thermal cycling and low thermal budget rapid thermal process (RTP). The rapid thermal process was performed in Ar, while furnace annealing had either N2 or O2 ambients. Chemical etch-pit delineation, x-ray topography and FTIR techniques were used to determine the bulk gettering and oxygen precipitation for the heat-treated Si substrates. Minority carrier generation lifetime and the change of oxygen content were measured before and after heat treatment. DOE

N86-30260# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
LASER-ASSISTED SOLAR CELL METALLIZATION PROCESSING Annual Report, 13 Dec. 1984 - 30 Sep. 1985
A. Rohatgi, P. G. McMullin, and T. W. OKeeffe Jan. 1986 57 p
(Contract DE-NAS7-100-9-56615)
(DE86-008328; DOE/JPL-956615/86/2) Avail: NTIS HC A04/MF A01

In this contract, Laser-assisted processing techniques for producing high-quality solar cell metallization patterns are being investigated, developed, and characterized. The tasks comprising these investigations are outlined. Four new batches of solar cells were processed, in addition to several test runs on wafers, using the laser decomposition of spun-on silver neodecanoate to metallize cells. Decomposition of silver neodecanoate was carried out at different laser powers on different cells on a given wafer to determine whether this would have any effect on cell performance. A one watt laser power gave an electroplated linewidth of 50 microns , while at 8 watts the line width was 90 microns. DOE

N86-30261# Foersvarets Forskingsansalt, Stockholm (Sweden).
CONTROL OF WINDPOWERED STATION WITH VARIABLE SPEED; SMALL RANGE
Bjoern Jakobsson and Eskil Ulen Feb. 1986 73 p In SWEDISH; ENGLISH summary
(FOA-C-20600-E3; ISSN-0347-3694; ESA-86-97237) Avail: NTIS HC A04/MF A01

Control of windpowered generators with maximum speed set to 20% over synchronous speed is discussed. A simulation package for electrical torque regulation and aerodynamic speed regulation was developed. Different configurations in the electric control (with and without integration) as well as different methods of damping the resonance between drive train compliance and generator inertia were studied. ESA

N86-30262# Foersvarets Forskingsansalt, Stockholm (Sweden).
CONTROL RESEARCH IN WINDPOWER PROJECT 506259-1 CONTROL FOA, STAGE 1 Final Report
Eskil Ulen Feb. 1986 14 p In SWEDISH; ENGLISH summary
(FOA-C-20601-E3; ISSN-0347-3694; ESA-86-97238) Avail: NTIS HC A02/MF A01

A simplified rotor blade control for engines with variable speed; resonance compensation; and turbulence and gust models for controller development are discussed. Control of windpowered generators, and the simulation of a stochastic process with nonrational spectrum are considered. Computer control programs for a windpowered electric power plant are mentioned. ESA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N86-30263# Air Force Occupational and Environmental Health Lab., Brooks AFB, Tex.
QUALITY ASSURANCE FOR WATER SAMPLING Final Report
Thomas C. Thomas and Ray I. Nakasone Feb. 1986 27 p
(AD-A165842; OEHL-86-015S0253BSA) Avail: NTIS HC A03/MF A01 CSCL 13/2

The quality assurance of water sampling is examined. Covered are sample collection, container types, sample preservation, holding times, shipment of samples, quality checks for field equipment and requirements for chain-of-custody forms. GRA

N86-30264# Oak Ridge National Lab., Tenn.
DATABASE ASSESSMENT OF POLLUTION CONTROL IN THE MILITARY EXPLOSIVES AND PROPELLANTS PRODUCTION INDUSTRY Final Report
Bimal C. Pal and Michael G. Ryon Feb. 1986 222 p
(Contract DE-AC05-85OR21400)
(AD-A165853; ORNL-6202) Avail: NTIS HC A10/MF A01 CSCL 13/2

A database on the current and proposed methods of pollution abatement in the munition production industry is presented. Information on current pollution status and waste treatment methods for the Army ammunition plants (AAPs) is also presented. Section 2 of this document deals with the physical and chemical properties of selected explosives, by-products, and related materials. Section 3 deals with the manufacture of the specific munitions. A scenario is presented in Section 4 to show the interaction among different agencies involved in the pollution abatement program. Actual and potential air pollution, water pollution, and solid wastes from the AAPs are covered in Sections 5 through 7. The current pollution and pollution abatement status of the various AAPs is discussed in Section 8. Modernization, waste management, monitoring programs, and regulatory aspects are the respective subject matter of Sections 9 through 12. Data gaps and research needs identified as a result of literature analysis are discussed throughout the document. The general term

TNT is used in this document to imply the specific isomer, alpha-trinitrotoluene. GRA

N86-30265# Oak Ridge National Lab., Tenn.
PANDORA: AN ELEVEN-BOX GEOCHEMICAL MODEL OF THE WORLD OCEAN
T. H. Peng and W. S. Broecker 1985 10 p Presented at the Carbon Transfer Conference, Lake Arrowhead, Calif., 5 May 1985 Prepared in cooperation with Lamont-Doherty Geological Observatory, Palisades, N.Y.
(Contract DE-AC05-84OR-21400)
(DE86-006122; CONF-8505239-1) Avail: NTIS HC A02/MF A01

To evaluate the impacts on the CO2 content of the atmosphere caused by possible differences between the operation of the glacial and the interglacial ocean-atmosphere systems, an 11-box global ocean model was developed which operates something like the real system. The individual reservoirs in this model are identified as (1) northern Atlantic. (2) surface Atlantic, (3) intermediate North Atlantic, (4) deep Atlantic, (5) intermediate South Atlantic, (6) surface Antarctic, (7) deep Antarctic, (8) intermediate Indopacific, (9) surface Indopacific, (10) deep Indopacific, and (11) northern Pacific. This report discusses the basic model structure. DOE

N86-30266# Lamont-Doherty Geological Observatory, Palisades, N. Y.
IMPACT OF CO2 ON THE CLIMATE CHANGE IN NORTH AMERICA DURING THE 20TH CENTURY Final Report, 1 Aug. 1984 - 31 Jul. 1985
G. J. Kukla Dec. 1985 11 p
(Contract DE-AC02-83ER-60162)
(DE86-006126; DOE/ER-60162/3) Avail: NTIS HC A02/MF A01

The geographic and seasonal pattern of changes in the mean maximum, minimum and average surface air temperature, as well as precipitation over North America between 1941 and 1980 was examined. An analysis of the data revealed a statistically significant decrease in the temperature range, particularly in summer and early autumn. The decrease in the range appears to be associated with increasing precipitation at many stations. However, further statistical tests have shown that increased precipitation, and by inference, atmospheric water vapor and cloud cover can not fully account for the large number of stations with a decreased range. Using climate division data over the United States, a recent increase in spring and summer temperature of approx.1(0)C and decrease in precipitation by 20 to 40% was found for the Central and Northern Great Plains. Comparisons of urban/rural station pairs in North America revealed an annual mean relative warming of the urban sites of between 0.12 and 0.15(0)C/decade. DOE

N86-30267# Duke Univ., Durham, N. C.
DIRECT EFFECTS OF INCREASING CARBON DIOXIDE ON VEGETATION
B. R. Strain, ed. and J. D. Cure, ed. Dec. 1985 304 p
(DE86-007397; DOE/ER-0238) Avail: NTIS HC A14/MF A01

CO2 is an essential environmental resource. It is required as a raw material of the orderly development of all green plants. As the availability of CO2 increases, perhaps reaching two or three times the concentration prevailing in preindustrial times, plants and all other organisms dependent on them for food will be affected. Humans are releasing a gaseous fertilizer into the global atmosphere in quantities sufficient to affect all life. This volume considers the direct effects of global CO2 fertilization on plants and thus on all other life. Separate abstracts have been prepared for individual papers. DOE

N86-30268# GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Physik.
DATA COLLECTION AND ANALYSIS FOR HCl, SO2, AND NO2 IMMISSION-EMISSION DIFFERENTIAL ABSORPTION LIDARS
A. Breinig, W. Staehr, W. Lahmann, H.-J. Heinrich, C. Weitkamp, and W. Michaelis 11 Sep. 1985 9 p Presented at Workshop on Differential Absorption Lidar (DIAL) Data Collection and Anal. Tech., Virginia Beach, Va., 18-21 Nov. 1985
(GKSS-85/E/53; ISSN-0344-9629; ESA-86-97409) Avail: NTIS HC A02/MF A01

Data collection and analysis with space-resolving differential absorption and scattering lidars are discussed. Results of a Monte-Carlo simulation of emission measurements in a randomly meandering plume are presented. Practical experience with a transportable land-based SO2/NO2 lidar and a shipborne device for HCl measurements in the marine atmosphere is reported. ESA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N86-30269 Institut d'Aeronomie Spatiale de Belgique, Brussels.
THE INFLUENCE OF NEGATIVE IONS ON THE INCOHERENT DIFFUSION OF ELECTROMAGNETIC WAVES IN THE D REGION OF THE IONOSPHERE Ph.D. Thesis - Brussels Univ., Belgium [INFLUENCE DES IONS NEGATIFS SUR LA DIFFUSION INCOHERENTE D'UNE ONDE ELECTROMAGNETIQUE DANS LA REGION D DE L'IONOSPHERE TERRESTRE]
J. Wisemberg 1985 283 p In FRENCH; ENGLISH summary
(Aeronomica-Acta-A-302-1985; ESA-86-97484) Avail: Issuing Activity

A systematic analysis of the chemistry of charged particles is developed using signal flow graph theory. A matrix formalism based on a hydrodynamic approach is presented. The method takes into account the fluctuations linked to the probabilistic aspect of the chemical reactions in the D region. A characteristic distance, different from the Debye distance, is introduced to relate the chemistry of negative ions to the power level and the width of the spectra. The use of equivalent models leads to a stochastic approach which describes the chemical fluctuations. The analysis and a numerical simulation method show that the chemical fluctuations are an important mechanism in the incoherent scattering. A research study of the form of the possibly observable spectra in the polar D region during corpuscular precipitation is presented. ESA

N86-30270# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
LATITUDINAL VARIATION OF DS
R. P. Kane May 1986 19 p Submitted for publication Sponsored by Fundo Nacional de Desenvolvimento Cientifico e Tecnologico
(INPE-3906-PRE/947) Avail: NTIS HC A02/MF A01

Using the data from several locations for a few selected events, the latitudinal variation of a storm-time logitudinal inequality component (DS) is studied. From a maximum near equator, DS seems to drop very sharply in the first 10 degree and then more slowly up to about 20 degrees, followed by an increase up to about 30 degrees. Some ionospheric contributions may be present during daytime. Author

N86-30271# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Ministerio da Ciencia e Tecnologia.
LONGITUDINAL DIFFERENCE IN THE Sq PROFILES IN THE SOUTH AMERICAN REGION
R. P. Kane Jul. 1986 10 p Submitted for publication Sponsored by the Fundo Nacional de Desenvolvimento Cientifico e Tecnologico
(INPE-3944-PRE/966) Avail: NTIS HC A02/MF A01

The average daily variation profiles of the H component at Huancayo on the west coast and Eusebio, Fortaleza, on the east coast in the dip equator region and La Quiaca near the west coast and Vassouras near the east coast in the southern low latitude region of the South American continent indicate that the profiles are broader for the east coast. Thus, distortions in the overhead current systems while passing from one coast to the other are indicated. Author

N86-30272*# Alabama Univ., Huntsville. School of Science.
THERMAL ION HEATING IN THE VICINITY OF THE PLASMAPAUSE: A DYNAMICS EXPLORER GUEST INVESTIGATION Final Report, Oct. 1984 - Mar. 1985
Richard H. Comfort Mar. 1986 13 p
(Grant NAG5-475)
(NASA-CR-176993; NAS 1.26:176993) Avail: NTIS HC A02/MF A01 CSCL 04A

The ion thermal structure of the plasmasphere was investigated in a series of experiments. It appears that energy may be generally available to ion and electrons in the vinicity of the plasmapause from Coulomb interactions between ambient thermal plasma and low energy ring current and suprathermal ions, particularly O+. The amount of energy transferred depends on the densities and energies of each of the components. The spatial distribution of heating in turn depends critically on the spatial distribution of the different populations, especially on the density gradients. The spatial distribution of the thermal plasma is found to vary significantly on a diurnal time scale and is complicated by the plasmasphere erosion and refilling processes associated with magnetic activity and its aftermath. Thermal ion composition also appears to be influenced by the heating taking place, often increasing the heavy ion population in the vicinity of the plasmapause. The observations of equatorial heating near the plasmapause in the presence of equatorial noise also raise the likelihood of a wave source of energy. It is not unreasonable to expect that both particle and wave heat sources are significant, although not necessarily at the same times and places. B.G.

N86-30273*# California Univ., Los Angeles. Dept. of Atmospheric Sciences.
PERTURBATIONS OF THE RICHARDSON NUMBER FIELD BY GRAVITY WAVES Final Technical Report, 1 May 1979 - 31 Dec. 1984
M. G. Wurtele and R. D. Sharman 1 Jul. 1985 74 p
(Grant NsG-4024)
(NASA-CR-176910; NAS 1.26:176910) Avail: NTIS HC A04/MF A01 CSCL 08N

An analytic solution is presented for a stratified fluid of arbitrary constant Richardson number. By computer aided analysis the perturbation fields, including that of the Richardson number can be calculated. The results of the linear analytic model were compared with nonlinear simulations, leading to the following conclusions: (1) the perturbations in the Richardson number field, when small, are produced primarily by the perturbations of the shear; (2) perturbations of in the Richardson number field, even when small, are not symmetric, the increase being significantly larger than the decrease (the linear analytic solution and the nonlinear simulations both confirm this result); (3) as the perturbations grow, this asymmetry increases, but more so in the nonlinear simulations than in the linear analysis; (4) for large perturbations of the shear flow, the static stability, as represented by N2, is the dominating mechanism, becoming zero or negative, and producing convective overturning; and (5) the convectional measure of linearity in lee wave theory, NH/U, is no longer the critical parameter (it is suggested that (H/u sub 0) (du sub 0/dz) takes on this role in a shearing flow). M.G.

N86-30274# Indian Inst. of Geomagnetism, Bombay.
[RESEARCH AND DEVELOPMENT ACTIVITIES OF THE INDIAN INSTITUTE OF GEOMAGNETISM] Annual Report, 1984 - 1985
Nanabhai Moos Marg 1985 72 p
Avail: NTIS HC A04/MF A01

Investigations on the following topics were performed during the year: variations of the quiet and disturbed day magnetic field, both in the equatorial region and outside it; electromagnetic induction studies using the array data as well as satellite data; physics of the ionosphere and radio-wave scintillations; magnetosphere and solar wind; and solar physics. A list of papers published or under publication during the year is given. Author

N86-30275*# Alabama Univ., Huntsville.
INTERNAL WAVE MOTION Progress Report, 1 Mar. - 31 Aug. 1986
R. J. Hung 1986 59 p
(NAS8-33726)
(NASA-CR-178871; NAS 1.26:178871) Avail: NTIS HC A04/MF A01 CSCL 04A

The distribution of atmospheric ozone is nonuniform both in space and time. Local ozone concentration vary with altitude, latitude, longitude, and season. Two year ozonesonde data, January 1981 to December 1982, observed at four Canadian stations and 2.5 year backscattered ultraviolet experiment data on the Nimbus-4 satellite, April 1970 to August 1972, observed over five American stations were used to study the relationship between the total ozone, vertical height distribution of the ozone mixing ratio, vertical height distribution of half total ozone, and the local tropopause height. The results show that there is a postive correlation between total ozone in Dobson Units and the tropopause height in terms of atmospheric pressure. This result suggests that local intrusion of the statosphere into the troposphere, or the local decreasing of tropopause height could occur if there is a local increasing of total ozone. A comparison of the vertical height distribution of the ozone mixing ratio, the modified pressure height of half total ozone and the tropopause height shows that the pressure height of an ozone mixing ratio of 0.3 micrograms/g, and the modified pressure height of half total ozone are very well correlated with the tropopause pressure height. Author

N86-30276# Air Force Geophysics Lab., Hanscom AFB, Mass.
TURBULENT HEATING AND TRANSFER IN THE STRATOSPHERE AND LOWER MESOSPHERE
Samuel P. Zimmerman and Thomas J. Keneshea 9 Aug. 1985 40 p
(AD-A166591; AFGL-TR-85-0184; AFGL-ERP-925) Avail: NTIS HC A03/MF A01 CSCL 04/1

The analysis of rocketsonde experimental data from 20 to 70 km altitude and from a latitude band 9.3 deg N to 76.6 N, grouped around longitude 78 deg W + or - 2.5 deg, results in the determination of the dynamically and statically unstable regions of the stratosphere and lower mesosphere. Richardson number normalization of the ratio of non-dimensional turbulent to mean parameters, allows us to extrapolate these results to the upper atmosphere. At the Richardson number (R sub i) indicated unstable regions, the steady state turbulent energy rate equation is solved, resulting in heat and momentum transfer coefficients, fluxes, and the rate of energy dissipation. Given contiguously unstable regions, the vertical heat and momentum flux divergences are also determined. Summer and winter averages of the results of these analyses are given. GRA

N86-30277# Illinois Univ., Urbana. Dept. of Atmospheric Sciences.
A CUMULUS PARAMETERIZATION STUDY WITH SPECIAL ATTENTION TO THE ARAKAWA-SCHUBERT SCHEME
Chih-Yue J. Kao and Yoshi Ogura Jun. 1985 224 p
(Contract F19628-82-K-0030)
(AD-A166801; AFGL-TR-85-0159; SR-1) Avail: NTIS HC A10/MF A01 CSCL 04/1

The importance of the vertical transports of heat, moisture, vorticity, and momentum by cumulus clouds has long been recognized not only in the numerical predictions of weather and climate but also in the simulation studies on mesoscale circulations such as tropical convective systems, mid-latitude frontogenesis, and the sea-land breeze. However, it is impractical to resolve those individual cumulus clouds because of the distinct scale difference between them and larger-scale circulations. In the past two decades, there have been numerous attempts to relate subgrid-scale cumulus convection to large-scale fields by specifying the cumulus activity as a function of large-scale variables, which is now commonly referred to as cumulus parameterization. The goal of cumulus parameterization is to predict the change of large-scale disturbances due to cumulus convection by describing not each of the many individual clouds, but only their collective effects. GRA

N86-30278# Naval Research Lab., Washington, D. C.
THE EFFECT OF FINITE BLOB SIZE ON THE CURRENT CONVECTIVE INSTABILITY IN THE AURORAL IONOSPHERE
J. D. Huba and P. K. Chaturvedi 11 Apr. 1986 36 p
(AD-A166806; NRL-MR-5730) Avail: NTIS HC A03/MF A01 CSCL 04/1

It has been suggested that the current convective instability may be responsible for the structuring, i.e., generation of density irregularities, of density enhancements (known as blobs) in the auroral ionosphere. However, previous theories have neglected the finite extent of the blob along the geomagnetic field. In this paper we develop a non-local theory of the current convective instability which considers the finite extent of an ionospheric blob parallel to the geomagnetic field. We find that the growth rate of the instability can be substantially reduced in the finite-sized blob case from the value obtained in the local approximation for an infinitely long blob. For auroral ionosphere parameters, the reduction in the growth rate for medium scale irregularities (1-10 km) can be one to two orders of magnitude for the typical observed values of blob sizes (approx. a few hundred km). Thus, it appears that the current convective instability is not a viable mechanism to generate scintillation causing irregularities, i.e., 1-10 km irregularities. GRA

N86-30279# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A STUDY OF NO GAMMA BANDS IN THE MESOSPHERE FROM SPACELAB 1 M.S. Thesis
Edward H. Erwin 1985 44 p
(AD-A166852; AD-E950814; AFIT/CI/NR-86-50T) Avail: NTIS HC A03/MF A01 CSCL 03B

The imaging Spectrometric Observatory obtained simultaneous spatial, as well as spectral data of NO in the mesosphere during the 1983 Spacelab 1 mission. The well-defined rotational lines of the 1-0 gamma band in the ultraviolet were used to infer atmospheric temperature profiles. The slant path intensity profiles exhibit higher intensities than are predicted by a recent model and are in good agreement with the NO profile obtained in the infrared during the same Spacelab 1 mission. GRA

N86-30280# Department of Energy, Washington, D. C. Carbon Dioxide Research Div.
ATMOSPHERIC CARBON DIOXIDE AND THE GLOBAL CARBON CYCLE
J. R. Trabalka, ed. Dec. 1985 327 p
(DE86-006222; DOE/ER-0239) Avail: NTIS HC A15/MF A01

This state-of-the-art volume presents discussions on the global cycle of carbon, the dynamic balance among global atmospheric CO2 sources and sinks. Separate abstracts have been prepared for the individual papers. DOE

N86-30281# Sandia National Labs., Albuquerque, N. Mex.
SOME THOUGHTS ON THE MODELING OF ATMOSPHERIC TURBULENCE FROM THE PERSPECTIVE OF A NON-EXPERT
D. Berg 1985 8 p Presented at the 14th IEA experts Meeting on Turbulence Loads on Wind Turbines, Stockholm, Sweden, 4 Dec. 1985
(Contract DE-AC04-76DP-00789)
(DE86-006498; SAND-86-0014C; CONF-851259-2) Avail: NTIS HC A02/MF A01

Recent work with a wind turbulence model has demonstrated that the effects of wind turbulence may be large. This work also illustrates that turbulence models do not need to accurately reproduce all the details in the physical wind to be of benefit to the wind turbine community. Their use, however, will be facilitated if they are packaged in easy-to-use codes that function as subroutines. Several US projects which are now in the planning stages are designed to measure the turbulence in the incident wind and the resultant response of the turbine. Knowledge gained from these tests will enhance our understanding of the role of turbulence in turbine response. DOE

N86-30282# Edgerton, Germeshausen and Grier, Inc., Los Alamos, N. Mex. Energy Measurements Group.
OCCULTATION OF THE ATS-3 SATELLITE BY THE AVEFRIA BARIUM ION CLOUD
T. J. Fitzgerald, D. J. Simons (Los Alamos National Lab., N. Mex.), M. B. Pongratz, and J. R. Clynch (Texas Univ., Austin.) Oct. 1985 28 p Prepared in cooperation with Los Alamos National Lab., NM.; Texas Univ., Austin.
(Contract DE-AC08-83NV-10282)
(DE86-008346; EGG-10282-5018) Avail: NTIS HC A03/MF A01

The barium ion cloud from the May 1978 AVEFRIA DOS barium release experiment occulted the line of sight (LOS) from the Antelope Valley, Nevada ground observation station to the ATS-3 satellite for approximately 5 minutes. This opportunity was used to measure and calculate the radio scintillations caused by the cloud. Optical measurements were compared to the radio measurements of scintillations. The barium cloud was measured optically with intensified cameras by viewing the 455.4-nm wavelength fluorescent ion line. The amplitude scintillations of the 136.47-MHz signal from the ATS-3 satellite were monitored. It was found that the radio scintillation patterns calculated from optical observations were approximately in agreement with the radio measurements. The calculated patterns are unable to produce the short timescale (less than a few seconds) details observed by radio, and contain time shifts due to cloud evolution not considered in the analysis. Possible sources for the limitations of the optical method are identified and recommendations are made for improvements. DOE

N86-30283# GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Physik.
REMOTE MEASUREMENT OF TROPOSPHERIC PARAMETERS BY LIDAR
C. Weitkamp 8 Nov. 1985 17 p Presented at Workshop on Experiences with the Application of Advanced Air Pollution Assessment Methods and Monitoring Techniques, Lindau, West Germany, 2-4 Oct. 1985
(GKSS-85/E/50; ISSN-0344-9629; ESA-86-97408) Avail: NTIS HC A02/MF A01

Emission and immission measurements and the investigation of transport phenomena of acid gases such as SO2, NO2, and HCl with a differential absorption and scattering lidar are described. A Raman lidar for CO2 and moisture profiling is presented. A Rayleigh temperature lidar is introduced. ESA

N86-30596*# New Mexico Univ., Albuquerque. Dept. of Geology.
STRATOSPHERIC DUST COLLECTIONS: VALUABLE RESOURCES FOR SPACE AND ATMOSPHERIC SCIENTISTS
Ian D. R. Mackinnon *In* Lunar and Planetary Inst. Trajectory Determination and Collection of Micrometeoroids on the Space Station 1986 p 68-69 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30597*# New Mexico Univ., Albuquerque. Dept. of Geology.
TARGETED FLIGHT OPPORTUNITIES WITH LARGE AREA COLLECTORS
Ian D. R. Mackinnon *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 70-71 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N86-30284 Delft Hydraulics Lab. (Netherlands).
FORECASTING CURRENT VELOCITY ON ROUTINE BASIS
R. A. H. Thabet and H. P. L. Vlasblom Sep. 1985 10 p Presented at the International Conference on Numerical and Hydraulical Modelling of Ports and Harbours, Birmingham, England, 23-25 Apr.

1985; sponsored by BHRA, Bedford, England and International Assoc. for Hydraulic Research
(Publ-345; ESA-86-97397) Copyright. Avail: Issuing Activity

A current forecast system was set up as an aid to executional operations of the storm surge barrier in the mouth of the Oosterschelde Estuary (Netherlands). The system uses deterministic models (hydraulic and mathematical) and/or time series analysis techniques. The application of frequency response functions to forecast (tidal) current velocity is discussed. The method is applicable for harbors and the like. An average error of almost nil and a standard deviation < 10% is achieved. ESA

N86-30285*# Dayton Univ., Ohio.
THE PHYSICAL AND EMPIRICAL BASIS FOR A SPECIFIC CLEAR-AIR TURBULENCE RISK INDEX Final Report, 2 Jul. 1982 - 30 Aug. 1985
John L. Keller Washington NASA Apr. 1986 48 p
(Contract NAS8-34687)
(NASA-CR-3971; NAS 1.26:3971) Avail: NTIS HC A03/MF A01 CSCL 04B

The fundamental emphasis of this research was to develop a technique which would be a significant improvement over those currently used for flight planning to avoid clear air turbulence (CAT). The technique should, ideally, be both quantitative in determining potential intensity and specific in locating regions of relatively high risk. Furthermore, it should not rely on specialized data but be functional using the currently available rawinsonde observation (raob) system. Encouraging results documented in an earlier investigation were considered compelling enough to warrant a closer look into the possibilities of a Specific Clear Air Turbulence Risk (SCATR) index approach to the clear air turbulence problem. Unlike that research, which considered sustained periods of flight in light to moderate clear air turbulence, this study focuses on several cases of documented severe CAT. Results of these case studies suggest that a SCATR index is not an unrealizable goal and that uses of such an index, event in its current prototype level of development, are also apparent. Author

N86-30286# Finnish Meteorological Inst., Helsinki.
THE DEVELOPMENT OF AGROMETEOROLOGICAL SERVICES IN FINLAND
Aulis Ansalehto, Esko Elomaa, Martti Esala, and Anneli Nordlund Dec. 1985 28 p
(FMI-TN-31; ISBN-951-697-231-4; ISSN-0355-1733) Avail: NTIS HC A03/MF A01

A study for developing meteorological and advisory service for agriculture was carried out in Finland for the years 1982 to 1984. The Finnish Meteorological Institute, the Agricultural Research Centre, the Association of Agricultural Producers in Finland formed a working group for the task. The goal was to present the requirements of agrometeorological research and the need of daily service, to estimate costs and benefits of the service and to make suggestions for the agrometeorological service in the whole country. In three growing seasons 1982 to 1984 the working group offered experimental services for farmers in a small area in southern Finland. For evaluating the service questionnaires were sent to farmers. The potential benefits and losses were also considered. The cost/benefit-ratio has been evaluated by agronomic experts and the work was based on the answers of farmers. It turned out to be 1/30. At the 1984 cost level, we could estimate the cost of a nationwide agrometeorological service at around FIM 4.2 million a year. The total yearly national benefit would then be around FIM 120 million. In 1985 the working group made its proposals for extending the agrometeorological service to the whole country during the years 1986 - 1991. Author

N86-30287*# Columbia Univ., New York.
ATMOSPHERIC, CLIMATIC AND ENVIRONMENTAL RESEARCH Semiannual Progress Report, 1 Oct. 1985 - 30 Sep. 1986
Wallace S. Broecker and Inez Fung 1986 15 p
(Contract NCC5-29)
(NASA-CR-176880; NAS 1.26:176880) Avail: NTIS HC A02/MF A01 CSCL 04B

Research conducted during the past year in the climate and atmospheric modeling programs was focused on the development of appropriate atmospheric and upper ocean models, and preliminary applications of these models. Principal models are a one-dimensional radiative-convection model, a three-dimensional global climate model, and an upper ocean model. Principal application is the study of the impact of CO2, aerosols and the solar constant on climate. Also the performance of the International Satellite Cloud Climatology Project cloud detection algorithm was evaluated, concentrating initially on its application to geosynchronous data, with an eventual switch of the developed methodologies to data from polar orbiting satellites. In the process, a number of improvements were made, in particular: an improved technique for tracking small scale day to day variability in clear sky continental temperatures; a number of techniques for the statistical assessment of cloud detection uncertainties due to cloud types which are spatially and temporally invariant; and a method used to detect those cloudy regions which have long term spatial and temporal stability. B.G.

N86-30288# Air Force Systems Command, Patrick AFB, Fla. Space and Missile Center.
APPLICATIONS OF SATELLITE METEOROLOGY IN SUPPORT OF SPACE SHUTTLE Technical Report, 1981 - 1985
B. B. Boyd, T. M. Myers, and C. S. Funk Dec. 1985 13 p
(AD-A166227; ESMC-TR-85-07) Avail: NTIS HC A02/MF A01 CSCL 04/2

The United States Air Force (USAF) Air Weather Service's Detachment 11 of the 2nd Weather Squadron is tasked to provide meteorological and environmental support to the USAF Eastern Space and Missile Center (ESMC), the National Aeronautics and Space Administration's (NASA) Kennedy Space Center (KSC), and the Department of Defense (DOD) Manager for Space Shuttle Support Operations. They provide weather support to the Cape Canaveral Air Force Station (CCAFS), Patrick Air Force Base (PAFB), KSC, and the entire Eastern Test Range (ETR); primarily through the Cape Canaveral Forecast Facility (CCFF). The CCFF is a 24-hour-a-day forecasting and observing operation. As part of its normal support, it provides specialized forecasts for all missile and space launches from the ETR/KSC and weather services for recovery forces. By far, the launch, landing, and ground operations of the Space Shuttle require the most precise weather support. Most aspects of Space Shuttle operations are sensitive to one or more meteorological parameters. As the Shuttle proved itself in its early missions and became operational with a significant increase in the number of scheduled missions, it was evident that weather and weather support would become critical elements in achieving and maintaining the higher launch rate. Through the efforts of the MSMP, and joint funding by the Air Force and NASA, several improvements in meteorological systems were accomplished, allowing better utilization of satellite data. GRA

N86-30289# Air Force Office of Scientific Research, Bolling AFB, Washington, D.C.
AFOSR (AIR FORCE OFFICE OF SCIENTIFIC RESEARCH) CHEMICAL AND ATMOSPHERIC SCIENCES PROGRAM REVIEW (29TH)
Larry P. Davis and Eunice L. Luther Sep. 1985 117 p
(AD-A166285; AFOSR-TR-85-0960) Avail: NTIS HC A06/MF A01 CSCL 04/2

A review is presented of research efforts sponsored by the Directorate of Chemical and Atmospheric Sciences which have completed their period of support. Illustrated accounts resulting from the basic research programs in the Atmospheric and Chemical Sciences are highlighted. The Atmospheric Science is concerned with meteorology and upper atmospheric structure and dynamics. The meteorology focuses on mesoscale meteorology, cloud physics, and atmospheric dynamics. The Chemical Sciences deal with chemical techniques, chemical structures, surface chemistry, chemical dynamics, and synthesis and properties of materials. GRA

N86-30290# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ANOMALOUS US WEATHER PATTERNS ACCOMPANYING STRATOSPHERIC SUDDEN WARMING M.S. Thesis
Donald A. Douglas May 1985 123 p
(AD-A166371; AFIT/CI/NR-86-8T) Avail: NTIS HC A06/MF A01 CSCL 04/1

Key signatures of tropospheric circulation are investigated for months during which major Stratospheric Sudden Warming (SSW) occurred in the period 1955 to 1980. For the contiguous United States, monthly values of cyclone frequency, storm paths, precipitation and surface temperature are determined for 17 January and February months and compared against the years in which no SSW events occurred. Consistent with studies of energetics which show that the troposphere loses energy to the stratosphere during SSW, cyclone frequency is approximately 22% less during SSW. Also, consistent with a modification of planetary-scale waves during SSW, mean storm tracks are altered. Most notably, the Colorado Low disappears during SSW. Precipitation totals reflect the changes in cyclone behavior. The Ohio River Valley is the most anomalously dry region of an abnormally dry United States during SSW. During February, the southwestern states exhibit anomalously high precipitation totals. Surface temperatures are significantly below normal, especially east of the Rocky Mountains. During January, every state shows below normal temperatures except Nevada. Author (GRA)

N86-30291# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
FACTORS LEADING TO THE FORMATION OF ARC CLOUD COMPLEXES M.S. Thesis
Mark John Welshinger Dec. 1985 123 p
(AD-A166501; AD-E750871; AFIT/CI/NR-86-11T) Avail: NTIS HC A06/MF A01 CSCL 04/1

As a thunderstorm propagates past a station there is a rise and oscillation of the surface pressure. Downdrafts descending from thunderstorm cells are the source of air forming a cold dome over the ground which leads to a rise in surface pressure. If the cold downdrafts are strong enough and last for a sufficient time, an organized high pressure system develops at the surface, which is called a mesohigh. In satellite imagery the leading edge of a mesohigh appears as an arc-shaped line of convective clouds moving out in all directions from a dissipating thunderstorm area. Twelve mesoscale convective systems (MCSs) were investigated. The duration of the gust front, produced by each MCS, was used to classify the MCSs. Category 1 MCSs were defined as ones that produced a gust front which lasted for more than 6 h; there were 7 category 1 MCSs in the sample. Category 2 MCSs were defined as ones that produced a gust front which lasted for 6 h or less; there were 4 category 2 MCSs. All the category 1 MCSs produced arc cloud complexes (ACCs), while only one of the category 2 MCSs produced an ACC. Composite analyses showed that Category 1 MCSs, on average, had higher thunderstorm heights, greater precipitation intensities, colder cloud top temperatures and produced larger magnitudes of surface divergence than category 2 MCSs. GRA

N86-30292# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
DAYTIME AND NIGHTTIME NEUTRAL WIND AND TEMPERATURE MEASUREMENTS FROM INCOHERENT SCATTER RADAR AT 300 KM OVER ARECIBO M.S. Thesis
Leslie O. Beisma Dec. 1985 40 p
(AD-A166600; AFIT/CI/NR-86-33T) Avail: NTIS HC A03/MF A01 CSCL 04/1

Arecibo's twenty acre spherical radar reflector detects the weak electromagnetic energy reflected when pulses are transmitted into the ionosphere. The information contained in this reflected energy reveals the electron temperature, the electron/ion temperature ratio, the line of sight plasma velocity and the electron density among other parameters. This information, combined with neutral densities obtained from the global thermospheric model based on Mass Spectrometer and Incoherent Scatter data, MSIS-83, is used to determine the neutral temperature and winds in the F region. This study pertains to the F2 region at a height of 300km over Arecibo (18 N latitude with a magnetic dip angle of 50). A few trends in previous data are noted, followed by a description of the 300km temperature and neutral wind for daytime and nighttime from 12 days of data, in sets of three days, from January 1984 and 1985, September 1984, and June, 1984. The experimental neutral temperature is compared to the MSIS model prediction. The observed temperature closely agrees in phase, but averages 50K lower than the mode l. GRA

N86-30293# Naval Research Lab., Washington, D. C.
SENSITIVITY OF REFRACTIVE INDEX PROFILE MODELS TO RELATIVE HUMIDITY SENSOR ERRORS
S. G. Gathman 27 Mar. 1986 39 p
(AD-A166626; NRL-MR-5758) Avail: NTIS HC A03/MF A01 CSCL 04/1

The problem of errors in the measurement of relative humidity from radiosondes and their possible effects on the detection of radar ducts in the boundary layer are discussed. Some numerical studies of the detection algorithm are presented. A statistical study of horizontal variations in relative humidity in the marine boundary is presented as a limitation on the accuracy requirement for data feeding into programs such as IREPS. A discussion of sensor development and a summary of sensor intercomparisons is included for completeness. GRA

N86-30294# Texas Technological Univ., Lubbock. Inst. for Disaster Research.
EXTREME WINDS AND TORNADOES: AN OVERVIEW
J. R. McDonald 1985 82 p Presented at the DOE Natural Phenomena Hazards Mitigation Conference, Las Vegas, Nev., 7 Oct. 1985
(Contract W-7405-eng-48)
(DE86-006162; UCRL-15745; CONF-8510118-Pt-4) Avail: NTIS HC A05/MF A01

The objective of this course on extreme winds, hurricanes, and tornadoes is to provide an overview of these natural phenomenon from the perspective of design of new buildings and structures or the evaluation of existing ones. Information is directly applicable to design and evaluation processes. The premise is that the facility under consideration, which may consist of various building, structures, processing equipment, stacks, ventilation ducts, etc., can be classified into certain categories, depending on the importance of the mission performed in the facility or the hazard that is presented by the particular operation. Having classified the facility into an appropriate category will automatically define certains design goals for the facility. The design goals are then met by selecting a design wind speed that is appropriate for the specified exceedance probability and by following certain specified design procedures. The problem then is to determine appropriate wind loads and other applicable loads, including dead loads, live loads, seismic loads, and other loads that may act on the structures. The design process can then proceed in the usual manner. In the case of existing facilities the strengths of the various structural elements, subsystems, and systems are evaluated and these strengths are related to wind speeds that would result in failure to neet the design goals. DOE

N86-30295# East Anglia Univ., Norwich (England).
GRID POINT SURFACE AIR TEMPERATURE DATA SET FOR THE SOUTHERN HEMISPHERE
P. D. Jones, S. C. B. Raper, C. M. Goodess, B. S. G. Cherry, and T. M. L. Wigley Feb. 1986 79 p
(Contracts DE-FG02-86ER60397; DE-AC02-79EV-10098)
(DE86-007205; DOE/EV-10098/6) Avail: NTIS HC A05/MF A01

A compilation of 610 station records of monthly surface air temperature has been assembled for the Southern Hemisphere, north of 62.5(0)S. In order to use these data to construct the first grid point temperature data set for the Southern Hemisphere, the homogeneity of each of the station records has been assessed. Each station has been classed into one of three groups: immediately usable, corrected, or uncorrectable. The results are presented in tabular form. Of the 610 station records, 293 were used to produce a gridded data set on a 5(0) latitude by 10(0) longitude grid between 5(0)S and 60(0)S inclusive. Grid point

anomalies for 1851 to 1984, with respect to the reference period 1951 to 1970, were interpolated from station data using a simple algorithm. In order to produce a best possible data set, Antarctic data were included after they became available in 1957. DOE

N86-30296# Oregon State Univ., Corvallis. Wind Resources Assessment Lab.
PACIFIC NORTHWEST WIND REGIONAL ENERGY ASSESSMENT PROGRAM. VOLUME 2. APPENDIX
R. W. Baker, J. E. Wade, W. Frick, R. J. Wittrup, and J. Buckley Oct. 1985 245 p
(Contract DE-AC79-81BP-25593)
(DE86-007114; DOE/BP-25593/1-Vol-2; BPA-85-19-Vol-2) Avail: NTIS HC A11/MF A01

This appendix includes site listings by state and maps, site screening matrix, and detailed area assessments. DOE

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N86-30297# Scripps Institution of Oceanography, La Jolla, Calif.
THE MAGNETIC EFFECTS OF SHALLOW WATER INTERNAL SOLITONS
Alan D. Chave Mar. 1986 52 p
(Contract N00014-85-C-0104)
(AD-A165852; SIO-REF-86-7) Avail: NTIS HC A04/MF A01 CSCL 08/3

Since internal waves are a common feature of the oceans, there has been some interest in computing their electromagnetic effects in order to assess their role in the oceanic electromagnetic environment. This report extends previous analyses to cover the electromagnetic effects of coastal internal wave packets. While no observations of the electromagnetic fields produced by them have been reported, the large amplitude of shallow water internal waves is expected to induce substantial electromagnetic anomalies. The report is organized into five sections. The next part contains a review of oceanographic observations of internal wave packets from both surface ships and satellite imagery. Section 3 outlines the hydrodynamic theory for nonlinear internal waves. Section 4 contains a derivation of expressions for the electromagnetic fields produced by an isolated internal solution both at the seafloor and above the sea surface. The last part of the report contains a discussion of the theoretical results, including a detailed look at the predicted magnetic field using measured parameters from three well-documented occurrences of internal wave packets.GRA

N86-30298# Washington Univ., Seattle.
AN INTRODUCTION TO ICE IN THE POLAR OCEANS
Gary A. Maykut Sep. 1985 116 p
(Contract N00014-84-C-0111)
(AD-A166140; APL-UW-8510) Avail: NTIS HC A06/MF A01 CSCL 08/12

This report provides a general review of the formation, growth, distribution, properties, and behavior of sea ice in the polar oceans. Aspects of sea ice that are discussed include its extent, formation, growth, heat balance, mass balance, mechanical properties, morphology, optical properties, salinity, structure, thermal properties, and thickness distribution. GRA

N86-30299# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
MECHANICAL PROPERTIES OF MULTI-YEAR SEA ICE. PHASE 2: TEST RESULTS
Gordon F. N. Cox, Jacqueline A. Richter-Menge, Wilford F. Weeks, Hazen Bosworth, and Nancy Perron Oct. 1985 84 p
(AD-A166333; CRREL-85-16) Avail: NTIS HC A05/MF A01 CSCL 08/12

This report presents the results of the second phase of a test program designed to obtain a comprehensive understanding of the mechanical properties of multi-year sea ice from the Alaskan Beaufort Sea. In Phase II, 62 constant-strain-rate uniaxial compression tests were performed on horizontal and vertical ice samples from multi-year pressure ridges to examine the effect of sample orientation on ice strength. Also conducted were 36 constant-strain-rate tension tests, 55 conventional triaxial tests and 35 constant-load compression tests on multi-year pressure ridge samples to provide data for developing ice yield criteria and constitutive laws. Data are presented on the strength, failure strain and modulus of multi-year sea ice under different loading conditions. The effects of ice temperature, porosity, structure, strain rate, confining pressure and sample orientation on the mechanical properties of multi-year sea ice are examined. GRA

N86-30300# Brown Univ., Providence, R. I. Dept. of Geological Sciences.
THE STABILITY OF LOW-LATITUDE SEA-SURFACE TEMPERATURES: AN EVALUATION OF THE CLIMAP RECONSTRUCTION WITH EMPHASIS ON THE POSITIVE SST ANOMALIES
Warren L. Prell Jul. 1985 53 p
(Contract DE-AC02-83ER-60167)
(DE85-016190; DOE/ER-60167/1) Avail: NTIS HC A04/MF A01

A global data base of species composition of planktonic foraminifera has been compiled from sea floor samples (NS=1-145). This database has been used to evaluate the CLIMAP (1981) paleotemperature estimates and as the basis for an alternative method of estimating past sea surface temperatures: the modern analog technique (MAT). Evaluation of the CLIMAP foraminiferal equations reveals that they generaly do not work well on oceans not included in their calibration database and that some Pacific estimates may be biased toward warm values. The MAT estimates of SST are shown to be similar or higher correlation coefficients and to have lower standard estimates of errors than the comparable CLIMAP equations. Application of both methods to the 18K data results in positive SST anomalies in the south central Pacific and western tropical Indian Ocean. This comparison indicates that the positive SST anomalies of the CLIMAP reconstruction are real and do not reflect methodological bias. DOE

N86-30301# Old Dominion Univ., Norfolk, Va.
CONTINENTAL SHELF PROCESSES AFFECTING THE OCEANOGRAPHY OF THE SOUTH ATLANTIC BIGHT Progress Report, 1 Jun. 1985 - 31 May 1986
L. P. Atkinson Jan. 1986 16 p
(Contract DE-FG05-85ER-60348)
(DE86-008212; DOE/ER-60348/1) Avail: NTIS HC A02/MF A01

The purpose was to investigate the processes involved in the transport of fresh water from the inner shelf to the outer shelf in the vicinity of the Charleston Bump during the spring season of high fresh water discharge. The distribution of temperature, salinity, nutrients, and humic fluorescence were determined so that flow fields and distributions of variables could be related to wind forcing events. The time change in nutrient concentration and salinity at selected locations was determined. DOE

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N86-30302*# National Aeronautics and Space Administration, Washington, D.C.
LIFE SCIENCES SPACE STATION PLANNING DOCUMENT: A REFERENCE PAYLOAD FOR THE LIFE SCIENCES RESEARCH FACILITY
Aug. 1986 132 p
(NASA-TM-89188; NAS 1.15:89188) Avail: NTIS HC A07/MF A01 CSCL 06B

The Space Station, projected for construction in the early 1990s, will be an orbiting, low-gravity, permanently manned facility providing unprecedented opportunities for scientific research. Facilities for Life Sciences research will include a pressurized

research laboratory, attached payloads, and platforms which will allow investigators to perform experiments in the crucial areas of Space Medicine, Space Biology, Exobiology, Biospherics and Controlled Ecological Life Support System (CELSS). These studies are designed to determine the consequences of long-term exposure to space conditions, with particular emphasis on assuring the permanent presence of humans in space. The applied and basic research to be performed, using humans, animals, and plants, will increase our understanding of the effects of the space environment on basic life processes. Facilities being planned for remote observations from platforms and attached payloads of biologically important elements and compounds in space and on other planets (Exobiology) will permit exploration of the relationship between the evolution of life and the universe. Space-based, global scale observations of terrestrial biology (Biospherics) will provide data critical for understanding and ultimately managing changes in the Earth's ecosystem. The life sciences community is encouraged to participate in the research potential the Space Station facilities will make possible. This document provides the range and scope of typical life sciences experiments which could be performed within a pressurized laboratory module on Space Station. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and weightlessness.

N86-30303*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE TEMPORAL RESPONSE OF BONE TO UNLOADING

Ruth K. Globus, Daniel D. Bikle (California Univ., San Francisco.), and Emily Morey-Holton 19 Dec. 1984 34 p Prepared in cooperation with Veterans Administration Hospital, San Francisco, Calif.

(Grant NAGw-236)

(NASA-TM-89228; NAS 1.15:89228) Avail: NTIS HC A03/MF A01 CSCL 06P

Rats were suspended by their tails with the forelimbs bearing the weight load to simulate the weightlessness of space flight. Growth in bone mass ceased by 1 week in the hindlimbs and lumbar vertebrae in growing rats, while growth in the forelimbs and cervical vertebrae remained unaffected. The effects of selective skeletal unloading on bone formation during 2 weeks of suspension was investigated using radio iostope incorporation (with Ca-45 and H-3 proline) and histomorphometry (with tetracycline labeling). The results of these studies were confirmed by histomorphometric measurements of bone formation using triple tetracycline labeling. This model of simulated weightlessness results in an initial inhibition of bone formation in the unloaded bones. This temporary cessation of bone formation is followed in the accretion of bone mass, which then resumes at a normal rate by 14 days, despite continued skeletal unloading. This cycle of inhibition and resumption of bone formation has profound implication for understanding bone dynamics durng space flight, immobilization, or bed rest and offers an opportunity to study the hormonal and mechanical factors that regulate bone formation. B.G.

N86-30304# Army Research Inst. of Environmental Medicine, Natick, Mass.

THERMOREGULATION AFTER ATROPINE AND PRALIDOXIME ADMINISTRATION

Margaret A. Kolka, Lou A. Stephenson, Stephen P. Bruttig, Bruce S. Cadarette, and Richard R. Gonzalez Mar. 1986 19 p

(AD-A165868) Avail: NTIS HC A02/MF A01 CSCL 06/15

The effects of intramuscular saline (control), atropine (2mg), pralidoxime (600 mg) or a combination of the two drugs on heat exchange was evaluated in four healthy males during moderately intense seated, cycle exercise (55% v02 peak) in a temperate environment (T sub a = 30.3 C, P sub W = 1.0 kPa). Esophageal, rectal, and mean skin temperatures, and chest and forearm sweating were continuously measured. Skin blood flow (FBF) from the forearm was measured twice each minute by venous occulusion plethysmography. Whole body sweating was calculated from weight changes. The expected result of atropine injection, decreased eccrine sweating (-60%, P 0.05) with ensuent elevated esophageal (+0.4C, $P<0.05$) and skin temperature (+2.1C, $P<0.05$) was observed relative to control. Heart rate (+28 b/min) and FBF (+9 ml/100cc) were higher after atropine. Pralidoxime, in general, did not affect the core and skin temperature responses to the exercise differently from control; however, a slightly elevated FBF (+3ml/100cc min, 33%) compensated for the reduction in whole body sweating (-45%, $p<0.05$) that we observed. The combination of the drugs resulted in significantly higher esophageal (0.4C) and skin (0.9C) temperatures than atropine alone, as has been previously shown. The thermoregulatory disadvantage of inhibited sweating by atropine was partially compensated for by enhanced skin blood flow in this environment where T sub a>T sub sk. Pralidoxime was shown to decrease whole body sweating, by a mechanism as yet unexplained. GRA

N86-30305# Army Research Inst. of Environmental Medicine, Natick, Mass.

HUMAN VASCULAR FLUID RESPONSES TO COLD STRESS ARE NOT ALTERED BY COLD ACCLIMATION

Andrew J. Young, Stephen R. Muza, Michael N. Sawka, and Kent B. Pandolf Mar. 1986 26 p

(AD-A165869; USARIEM-M-19/86) Avail: NTIS HC A03/MF A01 CSCL 06/19

Repeated cold water immersion can induce the development of an insulative type of cold acclimation in man. This investigation determined if repeated cold water immersion produced changes in vascular fluid response to cold stress in addition to the previously reported changes in thermoregulation. Seven male subjects performed a standardized cold air and cold water exposure before and again after a cold acclimation program. The cold acclimation program consisted of daily immersion (90 min) in cold water (18 C, stirred) repeated five times per week for five consecutive weeks. Cold acclimation did not alter the responses of plasma volume or electrolyte concentrations, nor urinary flow or electrolyte excretion during either cold air or cold water exposure. The percent reduction in plasma volume was larger ($P<0.01$) in cold water (-17%) than in cold air (-12%). Cold water immersion resulted in greater ($P<0.01$) diuresis than cold air exposure. Plasma K(+) concentration increased ($P<0.01$) during cold (both air and water) exposure while plasma Na(+) concentration was unchanged. Calculated renal clearance and urinary excretion rate of both Na(+) and K(+) increased during cold (both air and water) exposure. It is concluded that: (1)insulative cold acclimation does not influence vascular fluid responses to cold stress; and (2)although vascular fluid shifts, body cooling and diuresis are all greater in cold water than air, a consistent relationship among these parameters could not be established for an individual's response. GRA

N86-30306# Naval Submarine Medical Research Lab., Groton, Conn.

CALCIUM AND VITAMIN D METABOLISM IN SUBMARINERS: CARBON DIOXIDE, SUNLIGHT AND ABSORPTION CONSIDERATIONS

David M. Sack, M. Holick, and K. R. Bondi 15 Jan. 1986 25 p

(AD-A166292; NSMRL-1037) Avail: NTIS HC A02/MF A01 CSCL 06/16

A 42% decrease in 25(OH)vitamin D levels has been noted in subjects over the course of submarine patrols and is thought to be the result of prolonged sunlight deprivation. The influence of the submarine environment on absorption of ingested vitamin D has not been previously investigated. This study examines the vitamin D absorption patterns of 5 subjects at the beginning, middle, and end of a 69 day patrol on a normal diet and with no exposure to sunlight. It was found that the magnitude and pattern of absorption does not change appreciably. It is concluded that the absorption of vitamin D is not affected by the submarine environment and that any drop in 25(OH) vitamin D levels seen during patrol is caused by lack of sunlight, ultraviolet light in particular. Implications in terms of sunlight deprivation and calcium metabolism

are discussed in a historical review of calcium and vitamin D investigations on submarines. GRA

N86-30307# Army Research Inst. of Environmental Medicine, Natick, Mass.

AN ENVIRONMENTALLY-CONTROLLED EXTENDED-USE SMALL ANIMAL HYPOBARIC CHAMBER

James A. Devine and Allen Cymerman Apr. 1986 14 p (AD-A166729; USARIEM-M-23/86) Avail: NTIS HC A02/MF A01 CSCL 06/19

An environmentally-controlled extended-use small animal hypobaric chamber has been designed to study small laboratory animals at low barometric pressures for long periods of exposure. The rectangular chamber (91.4 x 71.1 x 50.8 cm) is constructed of aluminum plate and acrylic resin with a volume of 330,000 cc. A computer/data acquisition control unit provides for controlling and collecting data on pressure, temperature, and relative humidity (RH) for sustained operations. Altitude simulation is achieved using a two-stage, air-cooled vacuum pump with a displacement of 30 cc/min. The pressure within the chamber is controlled by an incremental throttling valve in the vacuum line. Temperature (0-100 C) is accomplished by using a remote-controlled constant temperature circulating bath. RH (20-80%) is regulated by pre-conditioning the ventilation purge air prior to entering the chamber. Acceptable levels of oxygen and carbon dioxide gases are maintained by purging with sufficient volumes of fresh air. GRA

N86-30308# Argonne National Lab., Ill.

MULTIPARAMETER DATA ACQUISITION SYSTEMS FOR STUDIES OF CIRCADIAN RHYTHMS

K. R. Groh, C. F. Ehret, W. J. Eisler, Jr., and D. A. LeBuis 1985 15 p Presented at the NATO Advanced Workshop on Chronobiotechnology, Cardiff, Wales, 21 Apr. 1985 (Contract W-31-109-eng-38) (DE86-004041; CONF-8504206-1) Avail: NTIS HC A02/MF A01

Long-term, simultaneous monitoring of multiple metabolic circadian cycles such as energy metabolism, animal activity, and body temperature together have revealed ultradian fine-structure rhythms which are dependent on circadian phase and the perturbations of environmental influences. Because of the variation between individual animals, these experiments need to have large sample sizes for each experimental condition. To this end we have designed, constructed, and used four microcomputer controlled data acquisition systems to collect circadian data from individually housed rats and mice. DOE

N86-30309# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

MEDICAL SELECTION AND PHYSIOLOGICAL TRAINING OF FUTURE FIGHTER AIRCREW

Loughton, England Dec. 1985 146 p refs In ENGLISH and FRENCH Conference held in Athens, Greece, 25-26 Apr. 1985 (AGARD-CP-396; ISBN-92-835-0385-6) Avail: NTIS H A07/MF A01

The conference proceedings reviewed and made recommendations with respect to the medical selection and physiological and physical training of pilots who are to operate future fighter aircraft. The relevant characteristics of a proposed USAF fighter and the European Fighter Aircraft were discussed and used as the basis for selection and training considerations. Contributors drew upon the experience of the medical selection of pilots for present fighter aircraft. The cardiovascular, vision, and vertebral column aspects of medical selection and monitoring are considered in depth and recommendations made as to the methods which should be employed in the future. The influence of physical fitness upon pilot performance is addressed. The philosophy and practice of physiological training of aircrews is reviewed with emphasis on the value of the human centrifuge in teaching G protective maneuvers. For individual titles, see N86-30310 through N86-30327.

N86-30310# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

AIRCREW ASPECTS OF UNITED STATED FUTURE FIGHTER AIRCRAFT

Richard D. Krobusek *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 5 p (For primary document see N86-30309 21-52) Avail: NTIS HC A07/MF A01

The cockpit environment of fighter aircraft for the year 2000 and beyond will undoubtedly need aircraft technologies and protective devices to meet the ever growing enemy challenge. Recent advances in aircraft structures, flight controls, sensors, multipurpose and touch-sensitive displays, voice recognition and synthesis, enemy defenses, and chemical/biological warfare (CBW) technologies will combine to create a cockpit environment for future fighter aircraft vastly different and potentially more complex than any previously encountered by aircrews. This integration of equipment and crewmembers will interact such that new stresses will be created and existing ones aggravated. Special maneuver capability through the use of direct side force may provide significant tactical advantage at the expense of stress due to lateral acceleration forces. A few of these current technologies and some of the driving forces which will affect the cockpit environment of tomorrow's aircraft will be identified and discussed briefly. These technologies, as well as others, should receive further study for their effects on the aircrew prior to application in future aircraft. Proper application of the results of these studies will prevent the unbridled growth of cockpit complexity. Author

N86-30311# Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

CANADIAN FORCES APPROACH TO AIRCREW MEDICAL SELECTION

Gary Gray *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 6 p (For primary document see N86-30309 21-52) Avail: NTIS HC A07/MF A01

With advances in aircraft performance capabilities and in medical screening technology, major changes in Canadian Forces aircrew medical screening procedures were proposed and are being introduced. In addition to the standard battery of tests, additional screening procedures being introduced or evaluated include drug screening for cannabinoids, contrast sensitivity function visual assessment, echocardiograms, cardiovascular risk assessment, pulmonary function testing, an aeromedical history questionnaire, and a psychosocial and clinical review by a flight surgeon. Screening electroencephalograms are being continued. This data is used to reject candidates who fail to meet slection standards, and to provide a Medical Suitabiliyt Rating for acceptable candidates. Of candidates screened 2.8% had positive tests for urinary cannabinoids. Contrast sensitivity norms for the aircrew candidate population are higher than for other populations studied. Contrast sensitivity may be helpful in assessing candidates whose vision is close to standards. This approach to initial medical screening should reduce attrition of experienced aircrew for medical reasons, and will enhance flight safety over the years to come. Author

N86-30312# Tactical Air Command, Langley AFB, Va.

MEDICAL SELECTION AND PHYSIOLOGICAL TRAINING OF FIGHTER PILOTS: A 1985 PERSPECTIVE AND OVERVIEW

Rufus M. DeHart *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 5 p (For primary document see N86-30309 21-52) Avail: NTIS HC A07/MF A01

From an aeromedical perspective, there are two major goals for the Tactical Air Force. The first is to reduce the aircraft mishap rate due to human factor variables. The second is to enchance pilot capability to perform in the modern fighter environment. Fighter pilots can perform in the 9G (sub z) environment effectively and safely if they are properly selected, educated, and trained. In addition to being good aviators, smart, and aggressive, fighter pilots must be physically healthy and in excellent physical condition.

A thorough understanding of high-G physiology and the personal physiological flight envelope is needed. Accomplishing the variety of initiatives required to realize these goals is an exciting challenge for the aerospace medical community. Author

N86-30313# School of Aerospace Medicine, Brooks AFB, Tex.
CARDIOVASCULAR STANDARDS FOR SELECTION AND RETENTION OF HIGH PERFORMANCE PILOTS IN THE USAF: PERSPECTIVES FOR THE NEXT DECADE
James R. Hickman, Jr., George M. McGranahan, Jr., Robert M. Paull, and Rufus M. DeHart (Tactical Air Command, Langley AFB, Va.) *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 7 p (For primary document see N86-30309 21-52)
Avail: NTIS HC A07/MF A01

Cardiovascular selection and retention standard must be based upon a number of considerations which are primarily epidemiological in nature. In young applicants, there is little rationale in the performance of expensive, labor intensive studies which yield nonspecific results, most of which are normal variants. Stress tests and Holter monitors fall into this category. Since the significance of nonspecific findings is determined by the presence or absence of underlying organic structural defects, it is recommended that testing in a young population be directed toward the detection of anatomical defects. It is also recommended that abnormal findings of a structural nature then be assessed with functional tests to determine whether the applicant may enter some form of aviation training or be disqualified from all training. B.G.

N86-30314# Centre Principal d'Expertises Medicales du Personnel Navigant de l'Aeronautique, Paris (France).
SELECTION AND MEDICAL TESTING OF MIRAGE 2000 PILOTS: REPORT OF ECHOCARDIOGRAPHY [SELECTION ET SURVEILLANCE MEDICALES DES PILOTES DE MIRAGE 2000: APPORT DE L'ECHOCARDIOGRAPHIE]
H. Ille, A. Didier, N. Allegrini, and C. Maurel *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 13 p In FRENCH (For primary document see N86-30309 21-52)
Avail: NTIS HC A07/MF A01

The use of echocardiological examinations in the selection of prospective combat aircraft crews is discussed. Included is a comparative study of two homogeneous pilot cohorts; one consists of 34 transport aircraft pilots, and the other consists of 32 combat pilots. It is shown that the two cohorts present the same anomalies of the right cardiac region (mitral valvular prolapsus). However, it is shown that the anomalies of the right cardiac region form a right ventricular dilation only in combat pilots. Two hypotheses were developed: that the anomalies are an adaptation of the right cardiac region to accelerations, or that they are a stage preceeding secondary myocardial shock due to aeronautical constraints. B.G.

N86-30315# Hopital d'Instruction des Armees, Versailles (France).
CONTINUOUS ECG MONITORING OF MIRAGE 2000 PILOTS (COMPARISON WITH MIRAGE 3 AND F1 PILOTS) [ENRIGISTREMENT CONTINU DE L'E.C.G. CHEZ LES PILOTES DE MIRAGE 2000 (COMPARAISON AVEC LES PILOTES DE MIRAGE 3 ET F1)]
A. Seigneuric, G. Leguay, J. P. Burlaton, G. Poyot, and M. Sylvestre *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 3 p In FRENCH (For primary document see N86-30309 21-52)
Avail: NTIS HC A07/MF A01

Continuous Electrocardiographic monitoring for a duration of 24 hours allows a comparison of a sample of 24 conventional combat aircraft pilots (Mirage III and FI), with 7 Mirage 2000 pilots. A comparison of problems due to excitability during flight does not show signification differences among the two groups. Problems due to solar repolarization were recorded only for high-performance aircraft pilots. Differences primarily included cardiac frequencies in flight; they were clearly lower for the Mirage 2000 pilots as observed acceleration was increased. This corresponds with the differences in characteristics of the two populations, pertaining to the different missions. It is shown that modern combat aircraft, characterized by intense and prolonged acceleration, are capable of causing a certain excitability factor for the pilots. It is important to determine the influence of this acceleration on the cardiovascular system. B.G.

N86-30316# Centre d'Essais en Vol, Bretigny-sur-Orge (France).
THE USE OF ECG CHANGES CAUSED BY ACCELERATION AS TOLERANCE PREDICITION FACTORS [LES MODIFICATIONS ELECTROCARDIOGRAPHIQUES INDUITES PAR LES ACCELERATIONS, FACTEUR PREDICTIF DE LA TOLERANCE]
J. H. Clere, H. Vielleford, and J. L. Poirier *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 7 p In FRENCH (For primary document see N86-30309 21-52)
Avail: NTIS HC A07/MF A01

High-G accelerations experienced by combat aircraft pilots are arythmogenic. Of 328 electrocardiographic (EKG) tests done on 146 subjects submitting to accelerations of 4 to 11 G at a duration of 20 to 60 seconds, 215 supraventricular anomalies were observed on 181 tests, and 37 ventricular anomalies were observed on 31 tests. The frequency of these anomalies are a function of the intensity of the acceleration. However, there appeared to be no correlation between the EKG anomalies and the hemodynamic phenomena caused by problems of visual function or psychomotor problems. Thus it is stated that EKG monitoring may be of interest for use as a prediction factor for acceleration tolerance. It is stated that the anomalies of rhythm are probably based on vagus reflexes caused by attempts by the heart to protect against the acceleration, as well as by the venous responses to the centrifuge. B.G.

N86-30317# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
ENTRY VISUAL STANDARDS AND OCULAR EXAMINATION TECHNIQUES FOR FUTURE FIGHTER AIRCREW
D. H. Brennan *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 6 p (For primary document see N86-30309 21-52)
Avail: NTIS HC A07/MF A01

The visual tasks of future fighter aircrew are likely to increase both in magnitude and complexity. The increasing adoption of devices for visual enhancement and protection, even now, poses problems for integration with spectacles. The visual standards required for initial selection for training as a pilot or navigator should, if numbers permit, be such that trained aircrew are unlikely to require a visual aid until presbyopia physiologically demands correction in the latter half of the fourth decade. The visual standards considered appropriate for future fighter aircrew and the related ocular examination techniques both conventional and those designed to test such specialized ocular functions as stereopsis, glare resistance, dark adaptation, hue discrimination, and modulation transfer function are discussed. Author

N86-30318# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France).
SENSITIVITY TO COLOR CONTRASTS AND THE SELECTION OF NAVIGATOR PERSONNEL [SENSIBILITE AU CONTRASTE EN COULEURS ET SELECTION DU PERSONNEL NAVIGANT]
J. P. Menu, G. Santucci, and C. Corbe *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 8 p In FRENCH (For primary document see N86-30309 21-52)
Avail: NTIS HC A07/MF A01

Using a specific psychophysical method, the sensitivity to color contrasts (FSC) was systematically tested for subjects undergoing ophthalmological examinations. Following FSC examinations, several subjects with ametrophic conditions were studied. The FSC examinations were modified to obtain the exact nature of the ophthalmological I problem. It is shown that there is a change in the spatial frequencies of the blue section for subjects with myopic disorders, and a change in the red section for far-sighted subjects. This change is shown to be proportional to the degree of

ametrophic disorder. Thus, FSC tests are proposed as a basis for tests for the selection of navigators. B.G.

N86-30319# School of Aerospace Medicine, Brooks AFB, Tex. Neurosciences Function.

COMPUTER ANALYSIS OF VISUAL AND VESTIBULAR OCULOMOTOR FUNCTION IN THE MEDICAL SELECTION OF FIGHTER AIRCREW MEMBERS

James W. Wolfe, Edward J. Engelken, and Kennith Stevens, W. *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 6 p (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

Methods for evaluating visual and vestibular-oculomotor function in aircrew members are reviewed. Three specific tests are described: pursuit tracking, harmonic angular acceleration, and saccadic tracking. In all of these tests, on-line computer analysis is used to quantify and describe the input/output relationships. An example of clinical data from pursuit tracking and harmonic angular acceleration tests for a patient with known pathology are used to demonstrate changes in test results. The major point is that it is now practical to evaluate oculomotor function in pilots and aircrew members selected for fighter aircraft duty. Author

N86-30320# Naval Aerospace Medical Research Lab., Pensacola, Fla.

VISUAL CAPABILITIES RELATED TO FIGHTER AIRCREW PERFORMANCE IN THE F-14 AND ADVERSARY AIRCRAFT

W. A. Monaco and P. V. Hamilton *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 9 p (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

Standards for aviation personnel should be based on capacities for performing critical tasks. The use of scores on task-relevant visual tests to predict air-to-air target detection performance of pilots involved in air combat maneuver (ACM) training was determined. A series of automated vision tests was determined in a mobile field laboratory located at a Tactical Air Combat Training System (TACTS) range. A computerized telemetry network provides extensive real time data on observer and target aircraft flight dynamics, and environmental parameters. A pilot's performance on each ACM engagement was measured by the slant range at the instant he sighted a target aircraft. Priminary analyses show that about 30% of the variance in the slant range is accounted for by flight dynamics, and environmental parameter, and vision data. Author

N86-30321# Naval Aerospace Medical Research Lab., Pensacola, Fla.

VISION TEST BATTERY THRESHOLD AND RESPONSE TIME AS PREDICTORS OF AIR-TO-AIR VISUAL TARGET ACQUISITION IN F-14 AND ADVERSARY AIRCRAFT

A. Morris, P. V. Hamilton, W. A. Morey, and R. P. Briggs (University of Southern California, Los Angeles.) *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 8 p (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

The Naval Aerospace Medical Research Laboratory (NAMRL) Vision Test Battery provides assessment of various visual functions, including spot detection, acuity at high and low contrast, glare sensitivity, and accommodative flexibility. Within these tests are measures of threshol, threshold-stressed response time (for near-threshold stimuli), and unconfounded response time (for supra-threshold stimuli). The contribution of response time variables to predicting flight performance was evaluated for 73 fighter pilots. Vision test data were compared to performance in air combat maneuver training. The distance (slant range) between the observer and target aircraft at time of initial visual detection was used as the performance variable. Availability of response time variables enhanced the ability to predict the air-to-air visual target detection performance of these pilots. Four vision variables accounted for about 32% of the variance in performance of those pilots who detected target aircraft at slant ranges greater than the group average. Prediction of performance is improved by incorporating other vision data and additional refinement of the performance measure. Author

N86-30322# Hopital d'Instruction des Armees, Paris (France).

THE VERTEBRAL COLUMN: SELECTION AND APTITUDE OF COMBAT AIRCRAFT PILOTS OF THE FUTURE [COLONNE VERTEBRALE: SELECTION ET APTITUDE DES PILOTES D'AVION DE COMBAT DU FUTUR]

P. J. Metges, J. Flageat, R. Aufret, R. P. Delahaye, and H. Vieillefond *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 3 p In FRENCH (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

The new generation of combat aircraft is characterized by the possibility of negative effects on the vertebral column due to extended or peak acceleration forces. In order to provide the pilot with optimal capacity for visual information assimilation, the cervical rachis must remain mobile and is therfore vulnerable under certain circumstances. Lesions may occur in this area during flight. Prevention of this condition is based on three elements: extensive radiological examination of the rachis for pilot applicants; technical improvements in helmet alignment; and physical adaptation training. B.G.

N86-30323# Militair Hospitaal Dr. A. Mathijsen, Utrecht (Netherlands).

SYSTEMATIC RADIOGRAPHIC EXAMINATION OF THE SPINE FOR SELECTION OF F-16 PILOTS: A PRELIMINARY REPORT

Albert vanDalen and Harry H. M. VanDenBiggelaar (Royal Netherlands Air Force, Soesterberg.) *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 4 p (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

With the introduction of the high performance aircraft F-16 in the Royal Netherlands Air Force an increase in spinal column disorders was anticipated. Therefore, a systematic whole spine radiography of candidate student pilots (CSPs) and qualified pilots (QPs) designated to fly F-16 were performed since December 1982. To reduce radiation exposure radiographs were made using a modern 14 inch intensifier. So far, 225 CSPs and 196 QPs were examined. Strict application of the medical criteria leads to a rejection of 20% of the CSPs because of spinal disorders visualized on X-ray. For F-16 pilots, the major region of interest seems to be the cervical spine. The rejection rate could be reduced by readjustment of the medical criteria and separate selection of helicopter and fighter pilots. Systematic examination of QPs who had no or incomplete previous examinations uncovers a high rate of spinal disorders. In the series QPs without any symptoms were only rejected because of cervical discopathy with osteophyte formation on the backside of the vertebrae and resulting narrowing of the spinal canal. Author

N86-30324# CEAM, Mont-de-Marsan (France).

PHYSICAL TRAINING OF MIRAGE 2000 PILOTS [ENTRAINEMENT PHYSIQUE DES PILOTES DE MIRAGE 2000]

G. Poyot, J. M. Clere, J. Lemot, and J. P. Delattre *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 5 p In FRENCH (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

Nine combat aircraft pilots underwent physical training specifically designed to increase their tolerance to acceleration forces. The suitability of the training was studied using centrifuge tests. The increase in tolerance could be attributed to the effects of the physical training or to an adaptation to the centrifuge. It is shown that together with an excellent original physical condition, specific physical training may increase the tolerance of acceleration forces. Further testing of this is expected. B.G.

N86-30325# Belgian Air Force, Brussels.

TREADMILL SPIROERGOMETRY IN THE SELECTION AND SCREENING OF HIGH-PERFORMANCE COMBAT AIRCRAFT

PILOTS IN THE BELGIAN AIR FORCE [SPIROERGOMETRIE SUR TAPIS ROULANT DANS LA SELECTION ET LA SURVEILLANCE DES PILOTES D'AVIONS A HAUTES PERFORMANCES DE LA FORCE AERIENNE BELGE]

G. Pirquin, J. Vastesaeger, and P. Vandenbosch *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 5 p In FRENCH (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

All pilots of the Belgian Air Force who were designated for conversion to the F-16 aircraft underwent cardiovascular and respiratory examinations. One of the tests was a test for maximum treadmill effort. In the first study, the results of the screening were combined with the results of tests conducted on a group of young candidate student pilots. The aerobic capacity of this population was then evaluated. The test sample included 156 persons of various ages and in different stages of physical conditioning. In the second study, the positive effects of physical training on the treadmill spiroergometric examination of a group of F-16 pilots were examined. B.G.

N86-30326# Naval Aerospace Medical Research Lab., Pensacola, Fla.

RELATIONSHIP OF CARDIOPULMONARY FITNESS TO FLIGHT PERFORMANCE IN TACTICAL AVIATION

G. R. Banta and J. D. Grissett *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 11 p (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

Current endeavors to identify whether cardiopulmonary fitness can positively influence flight performance in a tactical fighter community are discussed. Population analyses of experienced and student Naval aviators present evidence that the U. S. Navy aviation pilot community is in an above the average state of physical fitness with less than average coronary heart disease potential. Correlations found between cardiopulmonary fitness and psychophysiological responses that occur during simulated and/or actual flight operations present strong ecidence that flight performance could be favorably affected. Author

N86-30327# Naval Aerospace Medical Inst., Pensacola, Fla. Aviation Physiology Dept.

HYPOBARIC TRAINING OF FLIGHT PERSONNEL WITHOUT COMPROMISING QUALITY OF LIFE

Don Montelle Herron *In* AGARD Medical Selection and Physiological Training of Future Fighter Aircrew Dec. 1985 7 p (For primary document see N86-30309 21-52)

Avail: NTIS HC A07/MF A01

The increased incidence in decompression sickness during physiology training among U. S. Navy aircrew personnel and medical attendants requires a search for alternative means of permitting recognition and corrective action of hypoxia. The requirement for individual hypoxia training is considered valid not just by Navy regulations but by aeromedical practioners throughout the world. A proposal is made to utilize a gas mixture consisting of 7.4% oxygen and 92.6% nitrogen to induce hypoxia at ground level. This would permit ground level hypoxia training with similar symptoms of hypoxia as presently demonstrated at 25,000 feet in a decompresion chamber but would alleviate the primary cause of decompression sickness. All other U. S. Navy training objectives for the chamber exposure would be safely met and more efficiently demonstrated. The initial financial burden in modifying the existing decompression training chamber would be moderate when considering development and manufacturing of a new training device. The ultimate gain exists in decreased human suffering and the necessary return of credibility to the aeromedial training community. This is a must if we are to profess to do no harm. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N86-30328* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DIVISION OF ATTENTION AS A FUNCTION OF THE NUMBER OF STEPS, VISUAL SHIFTS, AND MEMORY LOAD

Richard A. Chechile (Tufts Univ., Medford, Mass.), Keith Butler, William Gutowski, and Everett A. Palmer 1986 11 p (Contract NCA2-OR785-801)

(NASA-TM-88775; NAS 1.15:88775) Avail: NTIS HC A02/MF A01

The effects on divided attention of visual shifts and long-term memory retrieval during a monitoring task are considered. A concurrent vigilance task was standardized under all experimental conditions. The results show that subjects can perform nearly perfectly on all of the time-shared tasks if long-term memory retrieval is not required for monitoring. With the requirement of memory retrieval, however, there was a large decrease in accuracy for all of the time-shared activities. It was concluded that the attentional demand of longterm memory retrieval is appreciable (even for a well-learned motor sequence), and thus memory retrieval results in a sizable reduction in the capability of subjects to divide their attention. A selected bibliography on the divided attention literature is provided. Author

N86-30329# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

THE EFFECT OF SPECTRALLY SELECTIVE FILTERS ON VISUAL SEARCH PERFORMANCE Final Report

G. T. Chisum, J. B. Sheehy, P. E. Morway, and G. K. Askew 8 Aug. 1985 17 p

(AD-A165835; NADC-85115-60) Avail: NTIS HC A02/MF A01 CSCL 06/16

The effect of five spectrally selective filters on the performance of an acuity dependent visual search task was evaluated. The filters were: (A)a neutral density filter (control condition); (B)a 52 00A green interference filter; (C)a 3215-250 red filter; (D)a neodymium visor; and (E)a holographic filter. The observers were presented with five blocks of ten slides per filter. Each slide projected a 6 by 6 deg field of 900 ten min of arc letter Os which contained a single Landolt C. The observers were required to search the field and report the orientation of the opening in the C. The opening in the C, which subtended 2.64 min of arc, required an acuity of 0.39 for detection. Response time, error rate, accommodative accuracy, and the number of fixations and their duration were recorded for each slide presentation. The results demonstrate that filter type had no effect on any of the response measures. During the first three trial blocks the observers appeared to optimize their search strategies, after which they began to revert to their initial performance levels. Although this effect was not supported statistically, this trend indicates that initially search proficiency increases with practice after which it is offset by fatigue. GRA

N86-30330# Pittsburgh Univ., Pa. Psychiatric Inst. and Clinic.

THE IMPORTANCE OF SPECIALIZED COGNITIVE FUNCTION IN THE SELECTION OF MILITARY PILOTS

Harold W. Gordon and Robert Leighty 19 Mar. 1986 43 p (Contract N00014-83-K-0208)

(AD-A165889) Avail: NTIS HC A03/MF A01 CSCL 05/10

Visuospatial skills significantly distinguished student Naval aviators who dropped out of aviation training from those who received their wings. While both groups were better than average on these tests, the winged aviators were better than the dropout group by 0.25 standard deviation which is highly significant ($P<0.0001$) for the total sample of 600 subjects. Performance on verbal-sequential skills did not distinguish between the groups. Logistic regression not only confirmed the group difference but demonstrated an interaction with verbal-sequential skills. High

performance on these skills helped the odds of being winged for aviators with low visuospatial ability but hindered those with high visuospatial ability. Distribution of visuospatial scores for the 2 groups demonstrated reasonable cut-off points at which considerably more drop-outs than winged aviators could have been eliminated. However, these data are relevant only for the selected sample of aviators accepted for the training programs. An additional study on the entire group of applicants including those rejected would allow comparison between the special cognitive tests used in this study and those already used as selection criteria. GRA

N86-30331# SRI International Corp., Menlo Park, Calif.
SPATIOTEMPORAL CHARACTERISTICS OF VISUAL LOCALIZATION Final Report, 1 Jun. 1982 - 31 Aug. 1985
Christina A. Burbeck 30 Oct. 1985 21 p
(Contract F49620-82-K-0024)
(AD-A166097; AFOSR-86-0109TR) Avail: NTIS HC A02/MF A01 CSCL 20/6

The main thrust of this research effort has been investigation of the spatial and temporal properties of the visual processes underlying relative spatial localization by human observers. The initial tasks were development of a suitable laboratory display system for generating the required stimuli, and development of appropriate experimental paradigms for studying the localization of widely separated objects. The second task was to make careful quantitative measurements of the spatial and temporal properties of the system underlying localization of widely separated objects. It was found that many of the stimulus manipulations that are critical in determination of contrast detection thresholds have little or no effect on localization accuracy. The relative localization of widely separated objects is a highly robust visual ability. Those variations in localization accuracy with changes in the spatial and temporal parameters of the stimulus that were obtained could readily be modeled as natural extensions of the threshold properties. The final task of this project was testing of existing models of spatial ability that can be accounted for by current models of spatial vision. Specific extensions of the existing model were suggested by the data. GRA

N86-30332# Nova Technical, Inc., Tarzana, Calif.
AN INVESTIGATION OF THE USE OF STEADY-STATE EVOKED POTENTIALS FOR HUMAN PERFORMANCE AND WORKLOAD ASSESSMENT AND CONTROL Final Technical Report, 15 Jun. 1983 - 14 Jun. 1985
Samuel L. Moise, Jr. Jun. 1985 66 p
(Contract F49620-83-C-0102)
(AD-A166205; AFOSR-86-0110TR) Avail: NTIS HC A04/MF A01 CSCL 05/10

This program of research investigated Steady-State Evoked Potential (SSEP) measures to determine their utility for evaluating sensory inputs, workload, and performance variables in human operators. A primary purpose was to find techniques and measures that could be generalized to groups of subjects in operational environments. SSEP measures included power (amplitude), coherence, phase lag, and Relative Transmission Time (RTT). Included in this effort were studies of: (1) Frequency masking, where multiple frequencies were presented simultaneously. (2) Sensory inputs which may manipulate SSEP (e.g., color, intensity, cross-modality stimulation). (3) Correlation of SSEP measures with fatigue and tack difficulty. (4) The relationship between performance in a tracking task and SSEP measures. GRA

N86-30333# New York Univ. Medical Center.
NOVEL ARCHITECTURES FOR IMAGE PROCESSING BASED ON COMPUTER SIMULATION AND PSYCHOPHYSICAL STUDIES OF HUMAN VISUAL CORTEX Final Report, 15 Apr. 1983 - 15 Apr. 1985
Eric L. Schwartz 2 Jan. 1986 96 p
(Contract F49620-83-C-0108)
(AD-A166222; AFOSR-86-0059TR) Avail: NTIS HC A05/MF A01 CSCL 05/10

This final report consists of two parts. The first part is a computer simulation of the functional architecture of the visual cortex, and an examination of the possible significance that this architecture may have for understanding both human visual computation and machine vision. The second part of this report is a psychophysical investigation of human shape perception in terms of boundary descriptors of curvature. GRA

N86-30334# Naval Submarine Medical Research Lab., Groton, Conn.
THE EFFECTS OF COLOR-CODING IN GEOSIT (GEOGRAPHICAL SITUATIONAL) DISPLAYS. 2: REDUNDANT VERSUS NON-REDUNDANT COLOR-CODING Interim Report
Alan R. Jacobsen, William H. Rogers, and David F. Neri 15 Jan. 1986 26 p
(AD-A166263; NSMRL-1069-2) Avail: NTIS HC A03/MF A01 CSCL 05/8

The effect on search time of redundant versus non-redundant color-coding of symbols in geographical situational (GEOSIT) displays was evaluated using 36 observers who were randomly assigned to three coding schemes: monochrome-coding, redundant color-coding, and non-redundant color-coding. In the color-coding schemes, only the threat information (Friendly, Unknown, and Hostile) was color coded, either redundantly with shape or not. The platform information (Submerged, Surface, and Airborne) was coded by shape in all three coding schemes. Performance when searching for the color-coded threat target categories was enhanced by over 100% compared to monochrome shape-coding. In addition, response time on the non-color-coded platform categories was significantly faster under the non-redundant color-coding scheme than under the redundant color-coding scheme. Author (GRA)

N86-30335# Institute for Perception Research, Eindhoven (Netherlands).
[ACTIVITIES REPORT IN PERCEPTION RESEARCH] Annual Report, 1984
1985 161 p
(IPO-19-1984; ESA-86-97398) Avail: NTIS HC A08/MF A01

Research concerning hearing and speech; vision and reading; cognition and communication; information ergonomics; communication aids for the handicapped; and perception studies instrumentation and software is summarized. ESA

N86-30336# Institute for Perception RVO-TNO, Soesterberg (Netherlands). Cognitive Psychology Group.
COGNITIVE ASPECTS OF COMMAND AND CONTROL
G. Keren and J. G. W. Raaijmakers Jan. 1986 45 p
(IZF-1986-2; TDCK-86-0580; ESA-86-97399) Avail: NTIS HC A03/MF A01

Topics and specific studies within cognitive sciences that have direct relevance to the functioning of a C3 unit are reviewed. Issues related to the manner in which information is obtained and processed, and the different aspects that are related to the decision process are discussed. Research subjects on command and control systems are suggested. ESA

N86-30337# Institute for Perception RVO-TNO, Soesterberg (Netherlands). Human Performance Group.
ATTENTION TASKS AND THEIR RELATION TO AGING AND FLIGHT EXPERIENCE
L. C. Boer Feb. 1986 28 p
(Contract A83/KLu/078)
(IZF-1986-4; TDCK-86-0585; ESA-86-97400) Avail: NTIS HC A03/MF A01

The Dichotic Listening Task (DLT) of Gopher and Kahneman (1971) was studied in a group of 143 aviators, aged between 17 and 70 yr. Other tasks of the study were the Continuous Memory Task (CMT) and two choice-RT tasks with visual stimuli. An attention questionnaire was also administered. Aging has negative effects on all tasks, especially on the DLT. With age factored out, no substantial correlations between DLT and other tasks are found. The only exception is a moderate correlation with choice RT. Differences between subgroups of aviators (42 airline pilots and

50 private pilots) were studied. The assumption was that airline pilots had higher levels of aviator skill. The DLT, CMT, and one of the RT tasks correlate with aviator subgroup. A second study with 16 flight cadets finds significant correlations between DLT and RT tasks on the one hand, and pilot gradings obtained later. It is concluded that DLT and RT tasks offer prospects for improving the selection of aviators. ESA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N86-30338*# California Univ., Davis. Dept. of Psychology.
IMPLICATIONS OF PRIVACY NEEDS AND INTERPERSONAL DISTANCING MECHANISMS FOR SPACE STATION DESIGN Progress Report, Jul. - Aug. 1985
Albert A. Harrison, Robert Sommer, Nancy Struthers, and Kathleen Hoyt 30 Aug. 1985 26 p
(Grant NAG2-357)
(NASA-CR-176938; NAS 1.26:176938) Avail: NTIS HC A03/MF A01 CSCL 05H

Privacy needs, or the need of people to regulate their degree of contact with one another, and interpersonal distancing mechanisms, which serve to satisfy these needs, are common in all cultures. Isolation, confinement, and other conditions accociated with space flight may at once accentuate privacy needs and limit the availability of certain common interpersonal contact. Loneliness occurs when people have less contact with one another than they desire. Crowding occurs when people have more contact with one another than they desire. Crowding, which is considered the greater threat to members of isolated and confined groups, can contribute to stress, a low quality of life, and poor performance. Drawing on the general literature on privacy, personal space, and interpersonal distancing, and on specialized literature on life aboard spacecraft and in spacecraft-analogous environments, a quantitative model for understanding privacy, interpersonal distancing, loneliness, and crowding was developed and the practical implications of this model for space station design were traced. Author

N86-30339*# SRI International Corp., Menlo Park, Calif.
SPECIFICATIONS PHYSIOLOGICAL MONITORING SYSTEM
15 Jul. 1985 73 p
(Contract NAS9-16811)
(NASA-CR-171926; NAS 1.26:171926) Avail: NTIS HC A04/MF A01 CSCL 06B

The operation of a physiological monitoring system (PMS) is described. Specifications were established for performance, design, interface, and test requirements. The PMS is a compact, microprocessor-based system, which can be worn in a pack on the body or may be mounted on a Spacelab rack or other appropriate structure. It consists of two modules, the Data Control Unit (DCU) and the Remote Control/Display Unit (RCDU). Its purpose is to collect and distribute data from physiological experiments in the Spacelab and in the Orbiter. Author

N86-30340# Clarke Ambrose, Inc., Knoxville, Tenn.
HUMAN FACTORS ACTIVITIES IN TELEOPERATOR DEVELOPMENT AT THE OAK RIDGE NATIONAL LABORATORY
J. V. Draper and J. N. Herndon 1986 15 p Presented at the International Topical Meeting on Advances in Human Factors in Nuclear Power Systems, Knoxville, Tenn., 21 Apr. 1986 Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE86-005160; CONF-860415-2) Avail: NTIS HC A02/MF A01

The Consolidated Fuel Reprocessing Program (CFRP) at the Oak Ridge National Laboratory is developing advanced teleoperator systems for maintenance of future nuclear reprocessing facilities. Remote maintenance systems developed by the CFRP emphasize man-in-the-loop teleoperation. Consequently, human factors issues which affect teleoperator performance must be addressed. This paper surveys research and development activities carried out by the human factors group within the Remote Control Engineering Task of the CFRP. DOE

N86-30341# Foersvarets Forskingsansalt, Stockholm (Sweden).
ASSISTED POSITIVE PRESSURE BREATHING AND MODIFIED ANTI-ACCELERATION SUIT FILLING TESTED UP TO 9 G IN A HUMAN CENTRIFUGE, KAROLINSKA INSTITUTE
Ulf I. Balldin Feb. 1986 14 p In SWEDISH; ENGLISH summary Sponsored by Swedish Material Administration of Armed Forces Air Material Department
(FOA-C-50038-H1; ISSN-0347-7665; ESA-86-97242) Avail: NTIS HC A02/MF A01

A modified anti-acceleration suit with ready pressure, faster filling, and higher end-pressure combined with normal breathing, and assisted and unassisted positive pressure breathing, was tested. Two acceleration-induced losses of consciousness occur at 8 to 9 G with normal breathing, but not with positive pressure breathing. Further negative physiological reactions are not recorded. Assisted positive pressure breathing is usually rated as best. Additional physical inconvenience occurs as a consequence of the high acceleration stresses, irrespective of equipment. ESA

55 PLANETARY BIOLOGY

Includes exobiology; and extraterrestrial life.

N86-30342*# Columbia Univ., New York.
EFFECTS OF SIMULATED WEIGHTLESSNESS ON MEIOSIS, FERTILIZATION, AND EARLY DEVELOPMENT IN MICE Final Report, 1 Jul. 1982 - 30 Apr. 1986
Debra J. Wolgemuth 1986 18 p
(Grant NAG2-324)
(NASA-CR-177106; NAS 1.26:177106) Avail: NTIS HC A02/MF A01 CSCL 06C

The initial goal was to construct a clinostat which could support mammalian cell culture. The clinostat was selected as a means by which to simulate microgravity conditions within the laboratory, by constant re-orientation of cells with respect to the gravity vector. The effects of this simulated microgravity on in-vitro meiotic maturation of oocytes, using mouse as the model system, was investigated. The effects of clinostat rotation on fertilization in-vitro was then examined. Specific endpoints included examining the timely appearance of male and female pronuclei (indicating fertilization) and the efficiency of extrusion of the second polar body. Particular attention was paid to detecting anomalies of fertilization, including parthenogenetic activation and multiple pronuclei. Finally, for the preliminary studies on mouse embryogenesis, a key feature of the clinostat was modified, that of the position of the cells during rotation. A means was found to immobilize the cells during the clinostat reotation, permitting the cells to remain at the axis of rotation yet not interfering with cellular development. B.G.

N86-30343*# Maryland Univ., Baltimore. Dept. of Neurology.
A POSSIBLE ROLE FOR ENDOGENOUS GLUCOCORTICOIDS IN ORCHIECTOMY-INDUCED ATROPHY OF THE RAT LEVATOR ANI MUSCLE: STUDIES WITH RU38486, A POTENT AND SELECTIVE ANTIGLUCOCORTICOID
Masaaki Konagaya (Nara Medical Coll., Japan) and Stephen R. Max Nov. 1985 17 p Submitted for publication
(Grant NAG2-100)
(NASA-CR-177029; NAS 1.26:177029) Avail: NTIS HC A02/MF A01 CSCL 06C

RU38486, a potent and selective antiglucocorticoid, was employed to study a possible role for endogenous glucocorticoids in atrophy of the levator ani muscle secondary to castration of male rats. RU38486 was shown to block (3H) triamcinolone acetonide binding to cytosol from levator ani muscle. Daily oral administration of RU38486 to castrated rats partially prevented

atrophy of the levator ani muscle, as well as a decrease in RNA concentration. In a control group receiving RU38486 alone, the levator ani underwent significant (20%) hypertrophy. Administration of exogenous dexamethasone also caused pronounced atrophy of the levator ani muscle. This atrophy was prevented, to a significant degree, by simultaneous oral administration of RU38486. It is concluded that endogenous glucocorticoids, the actions of which are blocked by RU38486, may be involved in regulation of the mass of the levator ani muscle in intact rats. M.G.

N86-30344# Pacific Northwest Lab., Richland, Wash.
BIOLOGICAL STUDIES OF SWINE EXPOSED TO 60-Hz ELECTRIC FIELDS. VOLUME 5: HEMATOLOGY AND SERUM CHEMISTRY Final Report
Dec. 1985 127 p
(Contract DE-AC06-76RL-01830)
(DE86-005362; EPRI-EA-4318-Vol-5) Avail: NTIS HC A07/MF A01

The hematologic and serum chemistry responses in three generations of miniature swine chronically exposed to a 30-kV/m, 60-Hz electric field have been assessed in a series of screening experiments. Based on comprehensive analyses and sequential statistical evaluation of the data, there are no significant differences in any hematologic parameters in either the F sub 0 or F sub 1 generations when the exposed and sham exposed groups are compared. In F sub 2 swine, at 42 days of age reticulocyte values were significantly higher in both sexes exposed to the electric field than in the control group. In addition, the exposed males at 42 days had significantly lower values for erythrocytes, hemoglobin and volume of packed red cells than the control males. Other values were comparable between exposed and control groups. Serum chemistry evaluations between exposed and control groups also showed no consistent statistical differences. A few parameters did show occasional differences between groups in the F sub 1 and F sub 2 generations, including: higher levels of urea nitrogen, triglyceride and alkaline phosphatase in exposed F sub 1 piglets; significantly lower serum protein levels in exposed F sub 2 males; and fewer serum globulins in both sexes of the F sub 2 generation. In summary, when hematologic and serum chemistry parameters were compared in exposed and sham-exposed groups of swine, some sporadic effects were evident. These effects, however, failed to replicate consistently at subsequent sampling periods or across generations and were not present as statistical trends when appropriate multivariate analyses were performed. DOE

N86-30345# Pacific Northwest Lab., Richland, Wash.
BIOLOGICAL STUDIES OF SWINE EXPOSED TO 60-Hz ELECTRIC FIELDS. VOLUME 6: IMMUNOLOGY Final Report
Dec. 1985 61 p
(Contract DE-AC06-76RL-01830)
(DE86-005363; EPRI-EA-4318-Vol-6) Avail: NTIS HC A04/MF A01

Immunological response in three generations of miniature swine chronically exposed to a 30-kV/m, 60-Hz electric field have been assessed in a series of screening experiments. The study was designed to investigate functional aspects of the humoral and cellular components of the mammalian immune system. Circulating levels of immunoglobulins were measured in parental-generation (F sub 0) sows (0 to 22 months of exposure), first-generation fetuses (F sub 1) at 100 days of gestation, F sub 1 females (0 to 32 months of exposure) and second-generation (F sub 2) weanlings at 1.5 and 6 months of age. No consistent, statistically significant changes in the levels of serum immunoglobins were observed when exposed groups were compared with sham-exposed controls, either within or across generations. An examination of cellular immunity included measurements of the mitogen response of peripheral-blood lymphocytes (PBL), spleen cells and lymph-node cells of F sub 0 sows sacrificed after 100 days of pregnancy, and PBL, spleen cells and thymocytes of F sub 1 fetuses at 100 days of gestation. Mitogen response studies of PBL, spleen cells, thymocytes and lymph-node cells of 42-day-old F sub 1 male weanlings and F sub 2 male and female swine were also conducted. In the statistical comparisons of mitogen-response data obtained for F sub 0 , F sub 1 , and F sub 2 swine, no consistent differences were observed between exposed and matched sham-exposed control groups. These observations indicate that the distribution of cells in the various tissues studied and the responses observed were not altered as a result of exposure to the fields. DOE

N86-30346# Southwest Research Inst., San Antonio, Tex.
EFFECTS OF 60 Hz ELECTRIC FIELD ON OPERANT AND SOCIAL STRESS BEHAVIORS OF NONHUMAN PRIMATES Technical Status Report, Jun. 8 - 2 Aug. 1985
2 Aug. 1985 19 p
(Contract DE-AC02-80RA-50219)
(DE85-016121; DOE/RA-50219/T5) Avail: NTIS HC A02/MF A01

Progress made at calibrating the electric field distribution within and around cages used for behavorial testing of baboons is described. It is concluded that all of the parts of the system are rather constant in their readings. The only component which seems to show appreciable variability is the 4 cm probe. Although the optically coupled 4 cm spherical dipole probe usually performs well, it is becoming apparent that sometimes it can produce misleading results. Although we do not yet understand the situation completely, it appears as though there are at least two variables affecting the probe, battery voltage and humidity. DOE

N86-30347# Southwest Research Inst., San Antonio, Tex.
EFFECTS OF 60 Hz ELECTRIC FIELDS ON OPERANT AND SOCIAL STRESS BEHAVIORS OF NONHUMAN PRIMATES Project Technical Status Report, 23 Nov. 1985 - 17 Jan. 1986
24 Jan. 1986 13 p
(Contract DE-AC02-80RA-50219)
(DE86-005807; DOE/RA-50219/T8) Avail: NTIS HC A02/MF A01

The objective was to investigate, using baboons (superspecies Papio cynocephalus) as surrogates, possible behavioral effects associated with exposure to high intensity 60 Hz electric fields. This program consists of four major projects. The first will evaluate the potential aversive character of exposure to 60 Hz electric fields by determining the threshold intensity which produces avoidance or escape responses. The second project will estimate the threshold intensity for detection of 60 Hz electric fields. The third will assess effects of chronic exposure to 60 Hz electric fields on the performance of two operant conditioning tasks, fixed ratio (FR) and differential reinforcement of low rate responding (DRL). The fourth will investigate the possible stress-inducing effects of chronic exposure to 60 Hz electric fields on the behavior of baboons living in small social groups. DOE

N86-30348# Institute of Nuclear Energy Research, Lung-Tan (Taiwan).
BACTERIAL INACTIVATION BY MEANS OF IONIZING RADIATION
M. S. Chang, L. H. Chen, and Y. K. Fu Nov. 1984 19 p In CHINESE and ENGLISH
(DE86-901038; INER-0575) Avail: NTIS (US Sales Only) HC A02/MF A01

Spores of Bacillus subtillis and Escherichia coli are the most common air-borne bacteria. B. subtilis is radiation resistant and is commonly used as the test strain for routine control of heat sterilization. A study of surviving fractions of spores of B. subtilis, E. coli, and Streptococcus faecium A21 irradiated by (60)Co gamma-rays was carried out to determine the suitable dose for medical sterilization by irradiation. DOE

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N86-30349*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DEVELOPMENT OF AN ALGORITHM TO MODEL AN AIRCRAFT EQUIPPED WITH A GENERIC CDTI DISPLAY
Wade C. Driscoll (Youngstown State Univ., Ohio.) and Jacob A. Houck Jul. 1986 58 p
(NASA-TM-87732; NAS 1.15:87732) Avail: NTIS HC A04/MF A01 CSCL 12A

A model of human pilot performance of a tracking task using a generic Cockpit Display of Traffic Information (CDTI) display is developed from experimental data. The tracking task is to use CDTI in tracking a leading aircraft at a nominal separation of three nautical miles over a prescribed trajectory in space. The analysis of the data resulting from a factorial design of experiments reveals that the tracking task performance depends on the pilot and his experience at performing the task. Performance was not strongly affected by the type of control system used (velocity vector control wheel steering versus 3D automatic flight path guidance and control). The model that is developed and verified results in state trajectories whose difference from the experimental state trajectories is small compared to the variation due to the pilot and experience factors. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering.*

N86-30350# Softech, Inc., Fairborn, Ohio.
ADA (TRADE NAME) COMPILER VALIDATION SUMMARY REPORT: SOFTECH, INC. ADAVAX COMPILER VERSION 2.47, VAX8600, VAX-11/780, VAX-11/785; AND MICROVAX 2 US ING VAX/VMS VERSION 4.1 AND MICROVMS 4.1M Report, 30 Aug. 1985 - 30 Aug. 1986
30 Aug. 1985 28 p
(AD-A166213) Avail: NTIS HC A03/MF A01 CSCL 09/2

The purpose of this Validation Summary Report is to present the results and conclusions of performing standardized tests on the SofTech-AdaVAX compiler, Version 2.47. On-site testing was performed by the Federal Software Management Support Center (FSMSC)--an Ada Validation Facility--in accordance with current Ada Validation Office policies and procedures. Testing was done on the VAX-11/780, the VAX-11/785, and the VAX 8600. The suite of test known as the Ada Compiler Validation Capability (ACVC), Version 1.6, was used. The ACVC suite of tests is used to validate conformance of the compiler to ANSI/MIL-STD-1815A (Ada). The SofTech Compiler AdaVAX, Version 2.47, using VAX/VMS 4.1 and MicroVMS 4.1M, were tested with version 1.6 of the ACVC validation tests. The SofTech AdaVAX Ada Compiler was also tested. GRA

N86-30351# Office of Software Development, Falls Church, Va. Federal Software Management Support Center.
ADA (TRADE NAME) COMPILER VALIDATION SUMMARY REPORT: DIGITAL EQUIPMENT CORPORATION VAX ADA COMPILER VERSION 1.1 VAX 8600, VAX-11/785, VAX-11/780, VAX-11/782, VAX-11/750, VAX-11/730, MICROVAX 1 AND 2 VAXSTATION 1 AND 2 USING VAX/VMS AND MICROVMS VERSION 4.2 AND VAXELN VERSION 2
6 Sep. 1985 28 p
(AD-A166354) Avail: NTIS HC A03/MF A01 CSCL 09/2

The purpose of this Validation Summary Report is to present the results and conclusions of performing standardized tests on the Digital Equipment Corporation VAX Ada Compiler. On-site testing was performed during 12-16 August 1985 at Digital Equipment Corporation, Nashua, New Hampshire, by an Ada Validation Facility, the Federal Software Management Support Center, according to current Ada Validation Office (AVO) policies and procedures. The DEC VAX Ada Compiler is hosted on those systems listed in the table below. The hosts, as well as selected VAX/VMS and VAXELN based systems served as the target systems. The suite of tests known as the Ada Compiler Validation Capability (ACVC), Version 1.6, was used. The ACVC is used to validate conformance of the compiler to ANSI/MIL-STD-1815A. This standard is described in the ANSI Ada Reference Manual, February 17, 1983. Not all tests in the ACVC test suite are applicable to this specific implementation. Also, known test errors in Version 1.6 are present in some tests; these tests were withdrawn. The purpose of the testing is to ensure that the compiler properly implements legal language constructs and that it identifies, rejects from processing, and labels illegal constructs. GRA

N86-30352# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/Logistics Dept.
TOFACS (TECHNICAL OFFICE AUTOMATION AND COMMUNICATION SYSTEM) SOFTWARE DEVELOPMENT AND ENHANCEMENTS FOR FISCAL YEAR 1983 - FISCAL YEAR 1985 Final Report, Oct. 1982 - Oct. 1985
Bob Wybraniec Feb. 1986 63 p
(AD-A166563; DTNSRDC/CMLD-86/06) Avail: NTIS HC A04/MF A01 CSCL 09/2

The Technical Office Automation and Communication System (TOFACS) is a pilot system that has been in operation for approximately five years. TOFACS provides users with workstations (terminal, modem and printer) and gives each user access to a comprehensive set of office automation capabilities such as electronic mail, document processing, calendar management, ticklers, and phone message management. Enhancements and development of new capabilities has improved the system and increased its overall functionality. This report chronicles the software enhancements and development made to TOFACS during fiscal years 1983 through 1985. GRA

N86-30353# Aeronautical Systems Div., Wright-Patterson AFB, Ohio. Information Systems and Technology Center.
ADA (TRADE NAME) COMPILER VALIDATION SUMMARY REPORT: INTERMETRICS, INC. I2ADA COMPILER, VERSION 17.08 FOR THE IBM 370 ARCHITECTURE UNDER UTS 2.3 Report, 10 Dec. 1985 - 10 Dec. 1986
10 Dec. 1985 68 p
(AD-A166818; AVF-VSR-22.0286) Avail: NTIS HC A04/MF A01 CSCL 09/2

This Validation Summary Report presents the results and conclusions of testing performed on the Intermetrics, Inc. I2Ada Compiler, Version 17.08. Standardized tests serve as input to an Ada complier, producing results which are evaluated by the validation team. This summary briefly states the highlights of the Intermetrics, Inc. I2Ada Complier, Version 17.08 validation. On-site testing was performed 6 Dec. 1985 through 10 Dec. 1985 at Intermetrics, Inc. in Cambridge MA under the auspices of the Ada Validation Facility (AVF), according to Ada (C.R.) Validation Office (AVO) policies and procedures. The Intermetrics, Inc. I2Ada Compiler, Version 17.08 is hosted on the IBM 370 architecture operating under UTS 2.3. The suite of tests known as the Ada Compiler Validation Capability (ACVC), Version 1.6, was used. The ACVC is used to validate conformance of a compiler to ANSI/MIL-STD-1815A Ada. The purpose of testing is to ensure that a compiler properly implements legal language constructs and that it identifies and rejects illegal language constructs. The testing also identifies behavior that is implementation dependent but permitted by the Ada Standard. Six classes of tests are used. These tests are designed to perform checks at compile time, at link time, or during execution. Author (GRA)

N86-30354# Lawrence Livermore National Lab., Calif.
MULTIPROCESSOR MODEL WITH DISTRIBUTED TASK CREATION
J. E. Wirsching Jun. 1985 47 p
(Contract W-7405-eng-48)
(DE86-005302; UCRL-53648) Avail: NTIS HC A03/MF A01

A model has been constructed that simulates the operation of

a multiprocessor by means of a computer program, MULTIMOD, which simulates the execution of a FORTRAN program. During the execution of MULTIMOD, all application program operands are moved from memory locations through connection networks and ancillary registers and queues to their destinations. (The model simulates hardware, including processors, memory modules, connection networks, and connective registers and queues.) The arithmetic of the application and all indexing are performed, and all loop operations are carried out. MULTIMOD times all work done, and mutual interference of all elements is accounted for. The present model requires the FORTRAN source program to be augmented, and the augmented FORTRAN program supports a completely decentralized task-creation method. The hardware modeled uses fully implemented Banyan networks or full crossbars for data and synchronization and a ring network for task handling. Two kinds of sentinels are used in handling operands: one kind is used to control data requests, and the second is used to describe the data state. In addition, MULTIMOD implements such concepts as OUT-OF-BOUNDS, READ-ONLY, LOCK, EMPTY/FULL, and TAG-MATCH. Whenever possible, the model uses data-flow-methods. DOE

N86-30355# European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1984 CERN SCHOOL OF COMPUTING
Jul. 1985 384 p Meeting held in Algua Blava, Spain, 9 Sep. 1984
(DE86-700783; CERN-85-09; CONF-8409223) Avail: NTIS (US Sales Only) HC A17/MF A01

The eighth CERN School of Computing covered subjects mainly related to computing for elementary-particle physics. These proceedings contain written versions of most of the lectures delivered at the School. Notes on the following topics are included: trigger and data-acquisition plans for the LEP experiments; unfolding methods in high-energy physics experiments; Monte Carlo techniques; relational data bases; data networks and open systems; the Newcastle connection; portable operating systems; expert systems; microprocessors - from basic chips to complete systems; algorithms for parallel computers; trends in supercomputers and computational physics; supercomputing and related national projects in Japan; application of VLSI in high-energy physics, and single-user systems. See hints under the relevant topics. DOE

N86-30356# Mess und System Technik G.m.b.H., Oberschleissheim (West Germany).
DIGITAL MAGNETIC TAPE MASS MEMORY STORE Final Report, Oct. 1984
Michael Horvatin Bonn Bundesministerium fuer Forschung und Technologie Dec. 1985 30 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-85-151; ISSN-0340-7608; ESA-86-97439) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 6.50

Two microprocessor-controlled high capacity mass storage devices were developed using standard cassette tapes or the cartridge DC 300. The development was based on the recording standard ECMA-34 and ECMA-46 for digital data on tapes. In order to increase the capacity, the standards concerning the recording codes and the flux change density were given up. The systems have the following features: the use of standard recording media; they are autonomous without the need of computer control; comfortable operating system and user commands; high capacity; and allround application possibilities. ESA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N86-30357*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROCEEDINGS OF TENTH ANNUAL SOFTWARE ENGINEERING WORKSHOP
Dec. 1985 366 p Workshop held in Greenbelt, Md., 4 Dec. 1985
(NASA-TM-88780; SEL-85-006; NAS 1.15:88780) Avail: NTIS HC A16/MF A01 CSCL 09B

Papers are presented on the following topics: measurement of software technology, recent studies of the Software Engineering Lab, software management tools, expert systems, error seeding as a program validation technique, software quality assurance, software engineering environments (including knowledge-based environments), the Distributed Computing Design System, and various Ada experiments. For individual titles, see N86-30358 through N86-30369.

N86-30358*# Maryland Univ., College Park. Dept. of Computer Science.
MEASURING THE SOFTWARE PROCESS AND PRODUCT: LESSONS LEARNED IN THE SEL
Victor R. Basili *In* NASA: Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 39 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

The software development process and product can and should be measured. The software measurement process at the Software Engineering Laboratory (SEL) has taught a major lesson: develop a goal-driven paradigm (also characterized as a goal/question/metric paradigm) for data collection. Project analysis under this paradigm leads to a design for evaluating and improving the methodology of software development and maintenance. J.P.B.

N86-30359*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STUDIES AND EXPERIMENTS IN THE SOFTWARE ENGINEERING LAB (SEL)
Frank E. McGarry and David N. Card (Computer Sciences Corp., El Segundo, Calif.) *In its* Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 37 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

The Software Engineering Laboratory (SEL) is an organization created nearly 10 years ago for the purpose of identifying, measuring and applying quality software engineering techniques in a production environment. The members of the SEL include NASA/Goddard Space Flight Center (GSFC, the sponsor and organizer), University of Maryland, and Computer Sciences Corporation. Since its inception the SEL has conducted numerous experiments, and has evaluated a wide range of software technologies. This paper describes several of the more recent experiments as well as some of the general conclusions to which the SEL has arrived. Author

N86-30360*# Reifer Consultants, Inc., Torrance, Calif.
SOFTWARE MANAGEMENT TOOLS: LESSONS LEARNED FROM USE
Donald J. Reifer, J. Valett (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.), J. Knight (Virginia Univ., Charlottesville), and G. Wenneson (Informatics General Corp., Palo Alto, Calif.) *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 23 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

Experience in inserting software project planning tools into more than 100 projects producing mission critical software are discussed. The problems the software project manager faces are listed along with methods and tools available to handle them. Experience is reported with the Project Manager's Workstation (PMW) and the SoftCost-R cost estimating package. Finally, the

results of a survey, which looked at what could be done in the future to overcome the problems experienced and build a set of truly useful tools, are presented. J.P.B.

N86-30361*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEASEL: AN EXPERT SYSTEM FOR SOFTWARE ENGINEERING
Jon D. Valett and Andrew Raskin *In its* Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 21 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

For the past ten year, the Software Engineering Laboratory (SEL) has been collecting data on software projects carried out in the Systems Development Branch of the Flight Dynamics Division at NASA's Goddard Space Flight Center. Through a series of studies using this data, much knowledge has been gained on how software is developed within this environment. Two years ago work began on a software tool which would make this knowledge readily available to software managers. Ideally, the Dynamic Management Information Tool (DynaMITe) will aid managers in comparison across projects, prediction of a project's future, and assessment of a project's current state. This paper describes an effort to create the assessment portion of DynaMITe, called the DynaMITe Expert Advisor for the SEL (DEASEL).Author

N86-30362*# Virginia Univ., Charlottesville. Dept. of Computer Science.
AN EXPERIMENTAL EVALUATION OF ERROR SEEDING AS A PROGRAM VALIDATION TECHNIQUE
John C. Knight and Paul E. Ammann *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 4 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

A previously reported experiment in error seeding as a program validation technique is summarized. The experiment was designed to test the validity of three assumptions on which the alleged effectiveness of error seeding is based. Errors were seeded into 17 functionally identical but independently programmed Pascal programs in such a way as to produce 408 programs, each with one seeded error. Using mean time to failure as a metric, results indicated that it is possible to generate seeded errors that are arbitrarily but not equally difficult to locate. Examination of indigenous errors demonstrated that these are also arbitrarily difficult to locate. These two results support the assumption that seeded and indigenous errors are approximately equally difficult to locate. However, the assumption that, for each type of error, all errors are equally difficult to locate was not borne out. Finally, since a seeded error occasionally corrected an indigenous error, the assumption that errors do not interfere with each other was proven wrong. Error seeding can be made useful by taking these results into account in modifying the underlying model. J.P.B.

N86-30363*# Informatics General Corp., Palo Alto, Calif.
QUALITY ASSURANCE SOFTWARE INSPECTIONS AT NASA AMES: METRICS FOR FEEDBACK AND MODIFICATION
Greg Wenneson *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 22 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

Software inspections are a set of formal technical review procedures held at selected key points during software development in order to find defects in software documents--is described in terms of history, participants, tools, procedures, statistics, and database analysis. J.P.B.

N86-30364*# Boeing Computer Services Co., Seattle, Wash.
A KNOWLEDGE BASED SOFTWARE ENGINEERING ENVIRONMENT TESTBED
Chris Gill, A. Reedy (Planning Research Corp., Washington, D. C.), and L. Baker (TRW Defense Systems Group, Cleveland, Ohio) *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 11 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

The Carnegie Group Incorporated and Boeing Computer Services Company are developing a testbed which will provide a framework for integrating conventional software engineering tools with Artificial Intelligence (AI) tools to promote automation and productivity. The emphasis is on the transfer of AI technology to the software development process. Experiments relate to AI issues such as scaling up, inference, and knowledge representation. In its first year, the project has created a model of software development by representing software activities; developed a module representation formalism to specify the behavior and structure of software objects; integrated the model with the formalism to identify shared representation and inheritance mechanisms; demonstrated object programming by writing procedures and applying them to software objects; used data-directed and goal-directed reasoning to, respectively, infer the cause of bugs and evaluate the appropriateness of a configuration; and demonstrated knowledge-based graphics. Future plans include introduction of knowledge-based systems for rapid prototyping or rescheduling; natural language interfaces; blackboard architecture; and distributed processing J.P.B.

N86-30365*# Planning Research Corp., Washington, D. C.
EXPERIENCE WITH A SOFTWARE ENGINEERING ENVIRONMENT FRAMEWORK
R. Blumberg, A. Reedy, and E. Yodis *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 25 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

Experience with a software engineering environment framework tool called the Automated Product Control Environment (APCE) is described. The goals of the framework design, an overview of the major functions and features of the framework, and implementation and use of the framework are presented. Aspects of the framework discussed include automation and control; portability, distributability, and interoperability; cost/benefit analysis; and productivity. Results of using the framework are discussed and the framework approach is briefly compared to other software development environment approaches. J.P.B.

N86-30366*# TRW Defense Systems Group, Huntsville, Ala.
ONE APPROACH FOR EVALUATING THE DISTRIBUTED COMPUTING DESIGN SYSTEM (DCDS)
John T. Ellis *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 24 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

The Distributed Computer Design System (DCDS) provides an integrated environment to support the life cycle of developing real-time distributed computing systems. The primary focus of DCDS is to significantly increase system reliability and software development productivity, and to minimize schedule and cost risk. DCDS consists of integrated methodologies, languages, and tools to support the life cycle of developing distributed software and systems. Smooth and well-defined transistions from phase to phase, language to language, and tool to tool provide a unique and unified environment. An approach to evaluating DCDS highlights its benefits. Author

N86-30367*# Century Computing, Inc., Laurel, Md.
EXPERIMENTS WITH ADA
D. Roy, M. McClimens (Mitre Corp., Bedford, Mass.), and W. Agresti (Computer Sciences Corp., Silver Spring, Md.) *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 42 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

A 1200-line Ada source code project simulating the most basic functions of an operations control center was developed. We selected George Cherry's Process Abstraction Methodology for

Embedded Large Applications (PAMELA) and DEC's Ada Compilation System (ACS) under VAX/VMS to build the software from requirements to acceptance test. The system runs faster than its FORTRAN implementation and was produced on schedule and under budget with an overall productivity in excess of 30 lines of Ada source code per day. Author

N86-30368*# Mitre Corp., Bedford, Mass.
OBSERVATIONS FROM A PROTOTYPE IMPLEMENTATION OF THE COMMON APSE INTERFACE SET (CAIS)
Mike McClimens, Rebecca Bowerman, Chuck Howell, Helen Gill, and Robbie Hutchison *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 29 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

This paper presents an overview of the Common Ada Programming Support Environment (APSE) Interface Set (CAIS), its purpose, and its history. The paper describes an internal research and development effort at the Mitre Corporation to implement a prototype version of the current CAIS specification and to rehost existing Ada software development tools onto the CAIS prototype. Based on this effort, observations are made on the maturity and functionality of the CAIS. These observations support the government's current policy of publicizing the CAIS specification as a baseline for public review in support of its evolution into a standard which can be mandated for use as Ada is today. Author

N86-30369*# Computer Sciences Corp., Silver Spring, Md.
MEASURING ADA AS A SOFTWARE DEVELOPMENT TECHNOLOGY IN THE SOFTWARE ENGINEERING LABORATORY (SEL)
William W. Agresti *In* NASA. Goddard Space Flight Center Proceedings of Tenth Annual Software Engineering Workshop Dec. 1985 36 p (For primary document see N86-30357 21-61)
Avail: NTIS HC A16/MF A01 CSCL 09B

An experiment is in progress to measure the effectiveness of Ada in the National Aeronautics and Space Administration/Goddard Space Flight Center flight dynamics software development environment. The experiment features the parallel development of software in FORTRAN and Ada. The experiment organization, objectives, and status are discussed. Experiences with an Ada training program and data from the development of a 5700-line Ada training exercise are reported. Author

N86-30370*# Colorado State Univ., Fort Collins. Inst. for Computational Studies.
REMOTE ACCESS FOR NAS: SUPERCOMPUTING IN A UNIVERSITY ENVIRONMENT Final Report, 1 Apr. 1985 - 31 Mar. 1986
Gary Johnson, Becky Olson, Julie Swisshelm, Dan Pryor, and John Ziebarth 31 Mar. 1986 60 p
(Contract NCC2-344)
(NASA-CR-177020; NAS 1.26:177020) Avail: NTIS HC A04/MF A01 CSCL 09B

The experiment was designed to assist the Numerical Aerodynamic Simulation (NAS) Project Office in the testing and evaluation of long haul communications for remote users. The objectives of this work were to: (1) use foreign workstations to remotely access the NAS system; (2) provide NAS with a link to a large university-based computing facility which can serve as a model for a regional node of the Long-Haul Communications Subsystem (LHCS); and (3) provide a tail circuit to the University of Colorado a Boulder thereby simulating the complete communications path from NAS through a regional node to an end-user. Author

N86-30371*# Texas Technological Coll., Lubbock. Dept. of Electrical Engineering/Computer Science.
A CANONICAL FORM FOR NONLINEAR SYSTEMS
Renjeng Su and L. R. Hunt (Texas Univ., Dallas.) 1986 21 p
(Grants NAG2-203; NAG2-189; Contracts N0014-76-C-1136; N00014-84-C-0104)
(NASA-CR-176974; NAS 1.26:176974) Avail: NTIS HC A02/MF A01 CSCL 09B

The concepts of transformation and canonical form have been used in analyzing linear systems. These ideas are extended to nonlinear systems. A coordinate system and a corresponding canonical form are developed for general nonlinear control systems. Their usefulness is demonstrated by showing that every feedback linearizable system becomes a system with only feedback paths in the canonical form. For control design involving a nonlinear system, one approach is to put the system in its canonical form and approximate by that part having only feedback paths. Author

N86-30372# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE ALGORITHM RMS-DIIS AND AN ALGOL PROGRAM FOR THE B-6800 COMPUTER TO DIAGONALIZE LARGE MATRICES
Mauricio Fabbri Apr. 1986 21 p Submitted for publication (INPE-3878-PRE/931) Avail: NTIS HC A02/MF A01

The recent RMS-DIIS method of Bendt and Zunger for large matrix eigenproblems is presented in some detail, together with its main limitations and a discussion of the approximations involved. Also included is a description of an ALGOL program available for immediate use in the B-6800 computer. Preliminary results are shown, which indicates that RMS-diIS can be, in some cases, one of the best developed techniques to isolate eigenvalue-eigenvector pairs from huge matrices. Author

N86-30373*# Eloret Corp., Sunnyvale, Calif.
THEORETICAL RESEARCH PROGRAM TO STUDY CHEMICAL REACTIONS IN AOTV BOW SHOCK TUBES Technical Progress Report, 1 Nov. 1985 - 30 Jun. 1986
Peter Taylor 30 Jun. 1986 69 p
(Contract NCC2-371)
(NASA-CR-176992; NAS 1.26:176992) Avail: NTIS HC A04/MF A01 CSCL 09B

Progress in the development of computational methods for the characterization of chemical reactions in aerobraking orbit transfer vehicle (AOTV) propulsive flows is reported. Two main areas of code development were undertaken: (1) the implementation of CASSCF (complete active space self-consistent field) and SCF (self-consistent field) analytical first derivatives on the CRAY X-MP; and (2) the installation of the complete set of electronic structure codes on the CRAY 2. In the area of application calculations the main effort was devoted to performing full configuration-interaction calculations and using these results to benchmark other methods. Preprints describing some of the systems studied are included. For individual titles, see N86-30374 through N86-30377.

N86-30374*# Eloret Corp., Sunnyvale, Calif.
INTEGRAL PROCESSING IN BEYOND-HARTREE-FOCK CALCULATIONS
Peter R. Taylor *In its* Theoretical Research Program to Study Chemical Reactions in AOTV Bow Shock Tubes 30 Jun. 1986 21 p (For primary document see N86-30373 21-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

The increasing rate at which improvements in processing capacity outstrip improvements in input/output performance of large computers has led to recent attempts to bypass generation of a disk-based integral file. The direct self-consistent field (SCF) method of Almlof and co-workers represents a very successful implementation of this approach. This paper is concerned with the extension of this general approach to configuration interaction (CI) and multiconfiguration-self-consistent field (MCSCF) calculations. After a discussion of the particular types of molecular orbital (MO) integrals for which -- at least for most current generation machines -- disk-based storage seems unavoidable, it is shown how all the necessary integrals can be obtained as matrix elements of Coulomb and exchange operators that can be calculated using a direct approach. Computational implementations of such a scheme are discussed. M.G.

N86-30375*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

BENCHMARK FULL CONFIGURATION-INTERACTION CALCULATIONS ON H2O, F- AND F

Charles W. Bauschlicher, Jr. and Peter R. Taylor (Eloret Corp., Sunnyvale, Calif.) *In* Eloret Corp. Theoretical Research Program to Study Chemical Reactions in AOTV Bow Shock Tubes 30 Jun. 1986 15 p (For primary document see N86-30373 21-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

Full configuration-interaction calculations are reported, and compared to other methods, for H2O at its equilibrium geometry and at two geometries with the H-O bonds stretched. Since the percentage of the self-consistent field (SCF) reference in the full configuration-interaction (FCI) wave function decreases greatly with the bond elongation, the accuracy of techniques based on a single reference do not compare well with the FCI results. However, the results from a complete active space SCF/multireference configuration-interaction (CASSCF/MRCI) treatment are in good agreement with the FCI. Correlation effects in F compared to Ne are far more similar than for F- compared to Ne, despite F- and Ne being isoelectronic. Since the importance of higher than double excitations is more important for F- than F, a very high percentage of the correlation must be obtained to accurately compute the electron affinity. In a CASSCF/MRCI treatment the higher than quadruple excitations contribute 0.02 eV to the electron affinity (EA), even for modest basis sets. M.G.

N86-30376*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

BENCHMARK FULL CONFIGURATION-INTERACTION CALCULATIONS ON HF AND NH2

Charles W. Bauschlicher, Jr., Stephen R. Langhoff, Peter R. Taylor (Eloret Corp., Sunnyvale, Calif.), Nicholas C. Handy (Cambridge Univ. (England).), and Peter J. Knowles (University of Western Ontario, London.) *In* Eloret Corp. Theoretical Research Program to Study Chemical Reactions in AOTV Bow Shock Tubes 30 Jun. 1986 16 p (For primary document see N86-30373 21-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

Full configuration-interaction (FCI) calculations are performed at selected geometries for the 1-sigma(+) state of HF and the 2-B(1) and 2-A(1) states of NH2 using both DZ and DZP gaussian basis sets. Higher excitations become more important when the bonds are stretched and the self-consistent field (SCF) reference becomes a poorer zeroth-order description of the wave function. The complete active space SCF - multireference configuration-interaction (CASSCF-MRCI) procedure gives excellent agreement with the FCI potentials, especially when corrected with a multi-reference analog of the Davidson correction. M.G.

N86-30377*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE ELECTRON AFFINITY OF THE OXYGEN ATOM

Charles W. Bauschlicher, Jr., Stephen R. Langhoff, Harry Partridge, and Peter R. Taylor (Eloret Corp., Sunnyvale, Calif.) *In* Eloret Corp. Theoretical Research Program to Study Chemical Reactions in AOTV Bow Shock Tubes 30 Jun. 1986 14 p (For primary document see N86-30373 21-61)
Avail: NTIS HC A04/MF A01 CSCL 09B

The electron affinity (EA) of oxygen is computed to be 1.287 eV, using 2p electron full configuration-interaction (CI) wave functions expanded in a 6s5p3d2f Slater-type orbital basis. The best complete active space self-consistent field - multireference CI (CASSCF-MRCI) result including only 2p correlation is 1.263 eV. However, inclusion of 2s intrashell and 2s2p intershell correlation increases the computed EA to 1.290 at the CASSCF-MRCI level. At the full CI basis set limit, the 2s contribution to the electron affinity is estimated to be as large as 0.1 eV. This study clearly establishes the synergistic effect between the higher excitations and basis set completeness on the electron affinity when the 2s electrons are correlated. M.G.

N86-30378*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SEARCH AND RETRIEVAL OF OFFICE FILES USING dBASE 3

William L. Breazeale and Charlotte R. Talley Aug. 1986 85 p
(NASA-TM-86550; NAS 1.15:86550) Avail: NTIS HC A05/MF A01 CSCL 09B

Described is a method of automating the office files retrieval process using a commercially available software package (dBASE III). The resulting product is a menu-driven computer program which requires no computer skills to operate. One part of the document is written for the potential user who has minimal computer experience and uses sample menu screens to explain the program; while a second part is oriented towards the computer literate individual and includes rather detailed descriptions of the methodology and search routines. Although much of the programming techniques are explained, this document is not intended to be a tutorial on dBASE III. It is hoped that the document will serve as a stimulus for other applications of dBASE III. Author

N86-30379*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DYNAMIC REMAPPING OF PARALLEL COMPUTATIONS WITH VARYING RESOURCE DEMANDS Final Report

David M. Nicol and Joel H. Saltz Jul. 1986 56 p Submitted for publication
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178150; ICASE-86-45; NAS 1.26:178150) Avail: NTIS HC A04/MF A01 CSCL 09B

A large class of computational problems is characterized by frequent synchronization, and computational requirements which change as a function of time. When such a problem must be solved on a message passing multiprocessor machine, the combination of these characteristics lead to system performance which decreases in time. Performance can be improved with periodic redistribution of computational load; however, redistribution can exact a sometimes large delay cost. We study the issue of deciding when to invoke a global load remapping mechanism. Such a decision policy must effectively weigh the costs of remapping against the performance benefits. We treat this problem by constructing two analytic models which exhibit stochastically decreasing performance. One model is quite tractable; we are able to describe the optimal remapping algorithm, and the optimal decision policy governing when to invoke that algorithm. However, computational complexity prohibits the use of the optimal remapping decision policy. We then study the performance of a general remapping policy on both analytic models. This policy attempts to minimize a statistic W(n) which measures the system degradation (including the cost of remapping) per computation step over a period of n steps. We show that as a function of time, the expected value of W(n) has at most one minimum, and that when this minimum exists it defines the optimal fixed-interval remapping policy. Our decision policy appeals to this result by remapping when it estimates that W(n) is minimized. Our performance data suggests that this policy effectively finds the natural frequency of remapping. We also use the analytic models to express the relationship between performance and remapping cost, number of processors, and the computation's stochastic activity. Author

N86-30380*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE FORCE ON THE FLEX: GLOBAL PARALLELISM AND PORTABILITY Final Report

Harry F. Jordan (Colorado Univ., Boulder.) Aug. 1986 22 p
(Contract NAS1-17070; Grant AF-AFOSR-0189-85)
(NASA-CR-178161; ICASE-86-54; NAS 1.26:178161) Avail: NTIS HC A02/MF A01 CSCL 09B

A parallel programming methodology, called the force, supports the construction of programs to be executed in parallel by an unspecified, but potentially large, number of processes. The methodology was originally developed on a pipelined, shared memory multiprocessor, the Denelcor HEP, and embodies the primitive operations of the force in a set of macros which expand into multiprocessor Fortran code. A small set of primitives is sufficient to write large parallel programs, and the system has been used to produce 10,000 line programs in computational fluid dynamics. The level of complexity of the force primitives is

intermediate. It is high enough to mask detailed architectural differences between multiprocessors but low enough to give the user control over performance. The system is being ported to a medium scale multiprocessor, the Flex/32, which is a 20 processor system with a mixture of shared and local memory. Memory organization and the type of processor synchronization supported by the hardware on the two machines lead to some differences in efficient implementations of the force primitives, but the user interface remains the same. An initial implementation was done by retargeting the macros to Flexible Computer Corporation's ConCurrent C language. Subsequently, the macros were caused to directly produce the system calls which form the basis for ConCurrent C. The implementation of the Fortran based system is in step with Flexible Computer Corporations's implementation of a Fortran system in the parallel environment. Author

N86-30381# Dunlap and Associates, Inc., Norwalk, Conn.
THE COMPUTER-AIDED ANALYTIC PROCESS MODEL. OPERATIONS HANDBOOK FOR THE ANALYTIC PROCESS MODEL DEMONSTRATION PACKAGE Research Note, May 1980 - Feb. 1983
Ronald G. Shapiro, Richard F. Bloom, and John F. Oates, Jr. Jan. 1986 65 p
(Contracts MDA903-80-C-0345; DA Proj. 2Q2-63743-A-794)
(AD-A166180; ARI-RN-86-06) Avail: NTIS HC A04/MF A01 CSCL 09/2

The objective of the computer-aided APM is to provide a routinized, thorough, adaptive and efficient procedure to help testers, analysts and researchers develop design specifications and evaluation measures for any planned or existing human-machine system, and especially for any training system. The demonstration version of the computer-aided model performs a sample of the routines expected in any ultimate version that may be developed in the future. Specifically, the demonstration model helps one to derive evaluation measures, but not design specifications. In addition, it contains data bases for training systems, but not for any other human-machine system. Finally, it contains data bases for only half of the six training subsystems (for design, enabling and delivery, but not for command, logistics or emplacement). For demonstration purposes, this development represents an appropriate and sufficient allocation of project resources, since the more significant effort was needed to develop the underlying concepts for both a feasible manual model and the computer-aided model. GRA

N86-30382# Naval Postgraduate School, Monterey, Calif.
ALGORITHM FOR SEGMENTATION OF MULTICHANNEL IMAGES M.S. Thesis
James F. Janecek Dec. 1985 44 p
(AD-A166215) Avail: NTIS HC A03/MF A01 CSCL 09/2

Segmentation is an important step in the computer based analysis of images. This thesis addresses the segmentation of images of multiple channels of data. Such images are referred to as multichannel images. Examples of these are color images, where the channels represent color components, and remote sensing data, where the channels may represent signals from various visible and infrared frequency bands. This thesis describes and demonstrates how segmentation of multichannel images into homogeneous regions can be accomplished using linear predictive filtering. Results are given for some synthetically generated color images of two textures. GRA

N86-30383# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Science.
A BROWSER FOR DIRECTED GRAPHS Technical Report, 15 Nov. 1981 - 30 Dec. 1985
Carl Meyer 30 Dec. 1985 63 p
(Contracts N00039-82-C-0235; ARPA Order 4031)
(AD-A166622) Avail: NTIS HC A04/MF A01 CSCL 09/2

The availability of low-cost workstations with a bit-mapped display and mouse has made possible widespread use of graphics software. User interfaces can display data through a convenient graphics interface rather than the textual presentations necessitated by older technology. One of the most applicable structures of computer science is a graph (i.e., a graph with vertices and edges as opposed to a drawing). If the graph drawing problems could be overcome, a tool could be written to browse through graphs using the natural graphical display. Such a tool, or graph browser, would display graphs in a reasonable format and allow users to query or edit the data represented by the graphs. This report describes the design of a general graph browser based on our experiences with an earlier prototype. Chapter 2 discusses the prototype and the limitations encountered with it. Chapter 3 describes the design of a general graph browser, called GRAB, and the user interface it provides. Chapter 4 describes an implementation design of GRAB, including the database design and the heuristics used to draw reasonable-looking graphs. Chapter 5 concludes with a summary and a discussion of future extensions to GRAB. GRA

N86-30384# Institute for Defense Analyses, Alexandria, Va.
THE STATUS OF VERIFICATION TECHNOLOGY FOR THE ADA (TRADEMARK) LANGUAGE Final Report
Karl A. Nyberg, Audrey A. Hook, and Jack F. Kramer Jul. 1985 43 p
(Contract MDA903-84-C-0031)
(AD-A166664; AD-E500758; IDA-P-1859; IDA/HQ-85-30214) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report provides a detailed research and development plan for the development and deployment of an Ada verification capability. The background, history, and goals of both Ada and verification are discussed. Specific recommendations for integrating verification technology in the software development process (particularly with Ada) are presented. The necessary research items to be pursued in support of the goals are also presented. This report consists of two major sections - the text and supporting appendices and references. The appendices generally describe efforts being undertaken in various areas and are annotated with status and points of contact for further information. GRA

N86-30385# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A DIGITAL FILTER FOR REMOVING KNOWN COMPONENTS FROM SPECTROSCOPIC DATA M.S. Thesis
Carey G. Mumford, III Aug. 1985 68 p
(AD-A166680; AFIT/CI/NR-86-36T) Avail: NTIS HC A04/MF A01 CSCL 07/4

This document presents a computational system designed to remove known components from spectroscopic data. The system realization is a FORTRAN-77 program; a listing of the program's source code is included in the Appendix. The program first performs a nine-point quadratic least-squares smoothing function. It then removes the known component with a non-recursive filter based on a least-squares prediction of the observed spectrum and a least-squares prediction of a computer generated synthetic spectrum of the known component. The program was tested using an artificial spectrum created for the sole purpose of testing the program's function. The program's function was verified with three segments of the 12 micron band of ethane taken from data recorded on the Fourier transform spectrometer at the McMath solar telescope at the Kitt Peak National Observatory. The segments are located near 804.0, 815.0, and 819.5/cm. Plots of the spectral data and of the resultant data are included. GRA

N86-30386# Brookhaven National Lab., Upton, N. Y.
PROCEEDINGS OF THE 4TH DOE WORKSHOP ON COMPUTER AIDED ENGINEERING
1985 54 p Workshop held at Upton, N.Y., 10 Oct. 1985
(Contract DE-AC02-76CH-00016)
(DE86-006129; BNL-51935; CONF-851060-Absts) Avail: NTIS HC A04/MF A01

The Proceedings for the Fourth DOE Workshop in Computer Aided Engineering follows the practice established in the three prior workshops in that only the abstracts or summaries of the presentations are published. Those wishing a more detailed manuscript of the work described are encouraged to contact the author directly. Most of the work described has been conducted

under contract to the US Department of Energy. The individual authors would be able to inform interested parties of any restrictions placed upon the use of the work described herein. DOE

N86-30387# Allied Bendix Corp., Kansas City, Mo.
INTELLIGENT N/C CONTROLLERS
V. E. Gross Oct. 1985 4 p Presented at the Joint Meeting of the CAM-I Advance Numerical Control (ANC), Process Planning (PP), and Quality Assurance Programs, Arlington, Tex., 30 Oct. 1985
(Contract DE-AC04-76DP-00613)
(DE86-003132; BDX-613-3398; CONF-8510211-1) Avail: NTIS HC A02/MF A01

The objective of this presentation is to initiate the discussion for the eventual preparation of a specification for intelligent numerical control N/C controllers. The items in this presentation are not intended to be all inclusive. This is a starting point for the research and preparation required to develop a specification. The intelligent N/C controller is defined and requirements, standards, and benefits are discussed. Development of specifications is recommended. DOE

N86-30388# Sandia National Labs., Albuquerque, N. Mex.
COMPOSITING DISSPLA OUTPUT WITH SYNTHETIC IMAGES ISSCO WEEK 86
J. Mareda 1986 8 p Presented at the ISSCO Week, New Orleans, La., 10 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-004555; SAND-85-2054C; CONF-860363-1) Avail: NTIS HC A02/MF A01

A number of graphics packages exist at Sandia to provide scientists and engineers a means of efficiently representing their data. These packages include DISSPLA, TELL-A-GRAF, Mapper, Movie BYU, Weasel, and some state of the art scene software currently under development. Some very enhanced graphics can be obtained by combining the output of some of these graphics packages. This presentation will discuss a method that was developed which allows incorporating the output of DISSPLA, the most widely used graphics package at Sandia for representing scientific data, with the scene software. The result of this combination is a high quality very informative graph. The procedures that are used to perform this combination will be discussed and many examples of the resulting output will be presented. The technique can be used for simply adding annotation to an image generated using the scene software or to add an attractive background from the scene software to a text slide made using DISSPLA. This technique can also be used to merge a ray-traced 3-D surface with a corresponding 3-D DISSPLA vector plot. This is how the two graphs from Sandia on the 1985 ISSCO poster for the Battle of the Artists were made. DOE

N86-30389# Argonne National Lab., Ill.
COMPARISON OF THE CRAY X-MP-4, FUJITSU VP-200, AND HITACHI S-810/20: AN ARGONNE PERSPECTIVE
J. J. Dongarra and A. Hinds Oct. 1985 48 p
(Contract W-31-109-eng-38)
(DE86-006665; ANL-85-19) Avail: NTIS HC A03/MF A01

A set of programs, gathered from major Argonne computer users, was run on the current generation of supercomputers: the CRAY X-MP-4, Fujitsu VP-200, and Hitachi S-810/20. The results show that a single processor of a CRAY X-MP-4 is a consistently strong performer over a wide range of problems. The Fujitsu and Hitachi excel on highly vectorized programs and offer an attractive opportunity to sites with IBM-compatible computers. DOE

N86-30390# Allied Bendix Corp., Kansas City, Mo.
ROBOTIC SIMULATION
B. L. Peck Feb. 1986 9 p
(Contract DE-AC04-76DP-00613)
(DE86-006517; BDX-613-3410) Avail: NTIS HC A02/MF A01

Simulation software offers great potential for cost savings and added assurance of maximum efficiency in manufacturing operations. It is estimated that 60 to 80% of a total robotic work cell implementation effort is involved in layout, equipment design, robot selection, and hardware mock up of the cell. The remainder of the effort is taken up with programming and final refinements made on the shop floor. Simulation techniques are also contributing significantly to development of offline programming. Simulation programs can offer a major cost savings. DOE

N86-30391# Department of Energy, Washington, D. C. Office of Energy Research.
ENERGY SCIENCES ADVANCED COMPUTATION PROGRAM PLAN
Feb. 1986 25 p
(DE86-006958; DOE/ER-0259) Avail: NTIS HC A02/MF A01

This document describes the Energy Sciences Advanced Computation (ESAC) activity of the Applied Mathematical Sciences program within the Office of Energy Research (ER) of the Department of Energy (DOE). It also describes the ESAC program plans for the next five fiscal years. These plans are derived from several sessions of a working group which was composed of researchers from DOE national laboratories and universities and which examined the ESAC activity to offer recommendations regarding the direction of this activity, and from a panel chaired by Dr. John Killeen, Director, National Magnetic Fusion Energy Computer Center, which investigated overall ER supercomputer issues and requirements. DOE

N86-30392# Los Alamos National Lab., N. Mex.
REFERENCE GUIDE FOR USING IGVIEW, AN IGES COMPATIBLE GEOMETRY DISPLAY, EDITING, AND ANALYSIS SYSTEM
R. M. Dolin and D. L. Jaeger Dec. 1985 46 p
(Contract W-7405-eng-36)
(DE86-007190; LA-10565-M) Avail: NTIS HC A03/MF A01

This report provides an introduction to the Initial Graphics Exchange Specification (IGES) compatible code called IGVIEW. This software can be used to display, edit, and analyze two-dimensional IGES formatted geometry. IGVIEW was written to comply with IGES version 2.0, which is the current national geometry standard. This report is intended only to serve as a reference manual for IGVIEW users. It contains a description of all the possible commands that can be used, and how to execute them. It details how to execute the code, read in a geometry file, and write a geometry file. There is also a discussion about what types of computer systems and terminals the current version of IGVIEW will support. The procedures for developing a material library are shown, and a short example library is provided. DOE

N86-30393# Sandia National Labs., Albuquerque, N. Mex.
SHARED MEMORY, CACHE, AND FRONTWIDTH CONSIDERATIONS IN MULTIFRONTAL ALGORITHM DEVELOPMENT
R. E. Benner 23 Jan. 1986 24 p
(Contract DE-AC04-76DP-00789)
(DE86-007245; SAND-85-2752) Avail: NTIS HC A02/MF A01

A concurrent, multifrontal algorithm (Benner and Weigand 1986) for solution of finite element equations was modified to better use the cache and shared memories on the ELXSI 6400, and to achieve better load balancing between child processes via frontwidth reduction. The changes were also tailored to use distributed memory machines efficiently by making most data local to individual processors. The test code initially used 8 Mbytes of incached shared memory and 155 cp (concurrent processor) sec (a speedup of 1.4) when run on 4 processors. The changes left only 50 Kbytes of uncached, and 470 Kbytes of cached, shared memory, plus 530 Kbytes of data local to each child process. Total cp time was reduced to 57 sec and speedup increased to 2.8 on 4 processors. Based on those results an addition to the ELXSI multitasking software, asynchronous I/O between processes, is proposed that would further decrease the shared memory requirements of the algorithm and make the ELXSI look like a distributed memory machine as far as algorithm development is concerned. This would make the ELXSI an extremely useful tool for further development of special-purpose, finite element computations. DOE

N86-30394# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. d'Informatique.
THE STEINER TREE PROBLEM. LINEAR PROGRAMMING MODEL AND DECOMPOSITION TECHNIQUE RESOLUTION Ph.D. Thesis [LE PROBLEME DE L'ARBRE DE STEINER. MODELISATION PAR PROGRAMMATION LINEAIRE ET RESOLUTION PAR DES TECHNIQUES DE DECOMPOSITION]
Lucile Guyard-Daher Oct. 1985 250 p In FRENCH
(ENST-85E010; ISSN-0751-1353; ESA-86-97214) Avail: NTIS HC A11/MF A01

A combinatorial optimization analysis is presented. A general linear programming analytical approach is detailed. A second heuristic approach allows the treatment of graphs with 200 peaks and 1500 arcs, with an error < 10%. The resolution of Steiner problems is discussed. The iteration complexity and the computer memory used by the methods discussed are compared, showing that the choice of algorithm may affect the cost factors by an order of magnitude. ESA

N86-30395# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communication.
WEIGHTED DECODING OF BLOCK LINEAR CODES Ph.D. Thesis [DECODAGE PONDERE DES CODES LINEAIRES EN BLOCS]
Juing Fang Jan. 1986 202 p In FRENCH
(ENST-86E001; ISSN-0751-1353; ESA-86-97216) Avail: NTIS HC A10/MF A01

A decoding algorithm was studied to determine its average complexity and its asymptotic behavior. Computerized simulations confirm the positive evaluation. Suboptimal Battail algorithm variants are examined and their simulation shows acceptable efficiency. The analysis and simulation shows that the channel nonuniform quantifying does not significantly improve the gain. Complexity theory is used to demonstrate that efficient probabilistic algorithms or polynomial time suboptimal algorithms are reasonable solutions. The modulations using a large number of states are also studied, concluding the error correcting codes may be useful for that case also. ESA

N86-30396# Technische Hogeschool, Eindhoven (Netherlands).
AN IMPROVED TEST FOR THE EQUALITY OF COEFFICIENTS OF VARIATION
R. Doornbos, J. Dijkstra, and J. B. Dijkstra Apr. 1984 9 p
(THE-RC-54335B; ESA-86-97307) Avail: NTIS HC A02/MF A01

The D-test for the quality of coefficients of variation in normal populations proposed by Doornbos and Dijkstra (1983) was modified. The modification yields a simpler algorithm; better control over the chosen size of the test; and a considerable improvement of the power. The last two remarks are especially true for small samples. ESA

N86-30397# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
REPORT ON THE AI TRIP
R. P. vandeRiet Mar. 1984 51 p
(IR-82; ESA-86-97320) Avail: NTIS HC A04/MF A01

The imbedding of AI in the whole of computer science; equipment; communication; and VLSI in the UK, USA, and Canada are discussed. Contacts between universities and industry are treated. ESA

N86-30398# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
A RELATIONAL DATABASE ENVIRONMENT FOR SOFTWARE DEVELOPMENT
Anthony I. Wasserman and Martin L. Kersten May 1984 20 p Sponsored by Netherlands Organization for the Advancement of Pure Research
(IR-86; ESA-86-97322) Avail: NTIS HC A02/MF A01

The software tool environment for the User Software Engineering (USE) methodology is built around a compact relational database management system (Troll/USE). Within this environment, called the Unified Support Environment, tools communicate with Troll/USE through message passing. Tools include a database browser and editor, a rapid prototyping system, and interactive database design aid, a data dictionary system, a programming language, and a version control/configuration management system. The way in which these tools support the USE methodology is described. The resulting environment is highly flexible and well suited for development of software systems and additional tools. ESA

N86-30399# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
AN ALGORITHM TO FIND MINIMAL SEQUENCES OF PASS DIRECTIONS FOR ATTRIBUTE GRAMMARS
Henk Alblas 1983 47 p
(INF-83-6; ESA-86-97371) Avail: NTIS HC A03/MF A01

A polynomial time algorithm that delivers a shortest sequence of pass directions for several simple multipass grammars is discussed. It starts from a given sequence of pass directions and tries to find a shorter one by considering possible distributions of the attributes over the passes and crossing out empty passes. An extension of the algorithm also reconsiders and possibly changes directions in order to find passes that become empty. The resulting sequences of pass directions are minimal with respect to the subsequence ordering, i.e., no subsequence exists for which an associated distribution of the attributes over the passes meets the simple multipass requirements. ESA

N86-30400# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
A NOTATION FOR THE MOST GENERAL FORM OF REPETITION
Maarten M. Fokkinga Feb. 1984 13 p
(INF-84-3; ESA-86-97372) Avail: NTIS HC A02/MF A01

A notation with which all forms of repetition, including WHILE, REPEAT, DO OD, IT TI, events, and multilevels exits can be written in a very simple and uniform way is presented. The notation uses recursion and name-giving as the canonical way to denote a large class of infinite programs in a finite way. ESA

N86-30401# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Informatics.
EXCEPTION HANDLING CONSTRUCTS CONSIDERED UNNECESSARY
Maarten M. Fokkinga Apr. 1984 13 p
(INF-84-8; ESA-86-97373) Avail: NTIS HC A02/MF A01

It is shown that, as Black (1982) argues, normal control structures, together with the data type discriminated union, suffice to replace exception handling facilities in a satisfactory way. Even with the discriminated union approach, incremental program construction is still possible. Programs using discriminated unions resemble the programs using exception handling facilities more than Black suggests. ESA

N86-30402# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
INPUT SIGNAL DESIGN FOR SYSTEM IDENTIFICATION; A COMPARATIVE ANALYSIS
A. Krolikowski and P. Eykhoff Oct. 1984 25 p
(ER-84/06; ESA-86-97526) Avail: NTIS HC A02/MF A01

Input signal design for system identification when the input signal is amplitude constrained and the input sequence is of finite-length is investigated. Optimality criteria used to derive the optimal identifying input sequence include Rissanen's Minimum Description Length criterion; the determinant of the information matrix; the information matrix determinant ratio; and the trace of the parameter error covariance matrix. These input design criteria can also be used in structure selection (multivariate systems) or in model order (univariate systems) estimation procedures. Autoregressive models are empasized, and the input signal sequences are derived using a dynamic programming approach. Analytical results and simulations are presented. ESA

N86-30403# Technische Hogeschool, Eindhoven (Netherlands).
ON-LINE DESIGN RULE CHECKER
L. Orbons 10 Jul. 1984 64 p
(ESA-86-97529) Avail: NTIS HC A04/MF A01

An on-line design rule checker for the interactive layout editors ISLE and CM was developed. It can check a layout consisting of paraxial rectangles for width and spacing violations. Error messages are immediatly reported to the designer, detected errors are also stored in error lists. The checker can also be used off-line. ESA

N86-30404*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A COLLECTION OF AREA OF INTEREST (AOI) ALGORITHMS Final Report
Ann Griesel, James Gillis, E. Drell, R. J. Gardner, and F. Lesh Jul. 1985 105 p
(Contract NAS7-918)
(NASA-CR-176984; JPL-D-171; NAS 1.26:176984; AD-A166509) Avail: NTIS HC A06/MF A01 CSCL 09/2

This report presents several independently developed and tested algorithms implemented in Pascal and FORTRAN 77 for determining if a point falls within a specified quadrilateral Area of Interest (AOI). These algorithms represent several ways of mathematically solving the AOI point inclusion problem, and provide a set of unclassified benchmarks against which existing system algorithms can be evaluated. Each of the other reports, listed in Appendix A, analyzes algorithms from several existing Intelligence and Electronic Warfare I/EW systems that perform a single function and examine their underlying mathematics. The main functional areas studied have been correlation, geographic transformations, and direction finding and location (fix) estimation. In this introductory section, the basic mathematical and geometric considerations on which the AOI algorithms presented later are based will be introduced, and the potential order dependence inherent in defining a polygon by the location of its vertices discussed. The second section presents the algorithms, and the third third section, an overview of testing results and algorithm evaluations. GRA

62 COMPUTER SYSTEMS

Includes computer networks.

N86-30405*# DeAnza Coll., Los Altos Hills, Calif.
OPTIMIZATION OF AN INTERACTIVE DISTRIBUTIVE COMPUTER NETWORK Final Report, Oct. 1979 - Dec. 1984
Vivian Frederick Jul. 1985 6 p
(Contract NCC2-31)
(NASA-CR-177373; NAS 1.26:177373) Avail: NTIS HC A02/MF A01 CSCL 09B

The activities under a cooperative agreement for the development of a computer network are briefly summarized. Research activities covered are: computer operating systems optimization and integration; software development and implementation of the IRIS (Infrared Imaging of Shuttle) Experiment; and software design, development, and implementation of the APS (Aerosol Particle System) Experiment. Author

N86-30406*# National Aeronautics and Space Administration, Washington, D.C.
ORGANIZATION OF THE CHANNEL-SWITCHING PROCESS IN PARALLEL COMPUTER SYSTEMS BASED ON A MATRIX OPTICAL SWITCH
Yu. V. Golomidov, S. K. Li, S. A. Popov, and V. B. Smolov Jul. 1986 23 p Transl. into ENGLISH from Elektronnoye Modelirovaniya (USSR), v. 6, Sep. - Oct. 1984 p 16-23; 39 Original language document was announced in IAA as A85-11834 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASw-4006)
(NASA-TM-88452; NAS 1.15:88452; ISSN-0204-3572) Avail: NTIS HC A02/MF A01 CSCL 09B

After a classification and analysis of electronic and optoelectronic switching devices, the design principles and structure of a matrix optical switch is described. The switching and pair-exclusion operations in this type of switch are examined, and a method for the optical switching of communication channels is elaborated. Finally, attention is given to the structural organization of a parallel computer system with a matrix optical switch. E.R.

N86-30407# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
DATAFLOW ARCHITECTURES Interim Report
David E. Culler 12 Feb. 1986 35 p
(Contract N00014-83-K-0125)
(AD-A166235; MIT/LCS/TM-294) Avail: NTIS HC A03/MF A01 CSCL 09/2

Dataflow graphs are described as a machine language for parallel machines. Static and dynamic dataflow architectures are presented as two implementations of the abstract dataflow model. Static dataflow allows at most one token per arc in dataflow graphs and thus only approximates the abstract model where unbounded token storage per arch is assumed. Dynamic architectures tag each token and keep them in a common pool of storage, thus permitting a better approximation of the abstract model. The relative merits of the two approaches are discussed. Functional data structures and I-structures are presented as two views of data structures which are both compatible with the dataflow model. These views are contrasted and compared in regard to efficiency and exploitation of potential parallelism in programs. A discussion of major dataflow projects and a prognosis for data flow architectures are also presented. Author (GRA)

N86-30408# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
PROTECTION AND RESOURCE CONTROL IN DISTRIBUTED OPERATING SYSTEMS
Sape J. Mullender and Andrew S. Tanebaum 15 Mar. 1984 31 p Revised
(IR-79; ESA-86-97319) Avail: NTIS HC A03/MF A01

A method to protect local networks against malicious users without placing any restrictions on the kinds of operating systems that can be constructed is discussed. Depending on the hardware, one-way functions or public key cryptography forms the basis for the protection. It is shown how a traditional object-oriented capability system can be implemented on top of the basic protection mechanism, and how a service for accounting and resource control can be constructed. ESA

N86-30409# Technische Hogeschool Twente, Enschede (Netherlands). Vakgroep: Interface, Protocol en Service Systemen.
FUNCTIONS WITHIN THE DATA COMMUNICATION LAYERS OF THE ISO OPEN SYSTEMS INTERCONNECTION (OSI) MODEL Ph.D. Thesis
A. Pras Mar. 1984 76 p
(INF83/IPS/042; ESA-86-97368) Avail: NTIS HC A05/MF A01

Two service types for the data-communication layers of the ISO-OSI model: the connectionless and the connection-oriented service, are discussed. The main difference between these service types is that the latter incorporates a three party negotiation phase. Although connection-orientation is one of the basic ideas behind the reference model for open system interconnection, the connection approach may not be the best for all data-communication layers. Many functions within these layers can also be performed with a connectionless service type. It is argued that it is possible with a connectionless network service to avoid congestion. ESA

N86-30410# Technische Hogeschool Twente, Enschede (Netherlands). Vagroep: Interface, Protocol en Service Systemen.
A FORMAL DESCRIPTION TECHNIQUE AND THE ISO TRANSPORT LAYER Ph.D. Thesis
J. W. C. Trouwee Mar. 1984 102 p
(INF83/IPS/007; ESA-86-97369) Avail: NTIS HC A06/MF A01

A formal specification language for protocol systems, based on the temporal ordering of interaction primitives, was studied to

aid standardizing the ISO Reference Model for Open System Interconnection (OSI). The specification of these standards has to be done unambiguously in a formal language. The way the language can be used to specify the OSI standards was assessed by describing formally the Transport Service-standard and Transport Protocol-standard from the ISO Reference Model. From the standards, a functional substructure was constructed. ESA

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N86-30411# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.

OVERVIEW OF ROME: A REASON-ORIENTED MODELING ENVIRONMENT Interim Report

Donald W. Kosy and Ben P. Wise Dec. 1985 19 p

(AD-A166259; CMU-RI-TR-85-21) Avail: NTIS HC A02/MF A01 CSCL 09/2

The ROME system is an experimental decision support system (DSS) generator that incorporates facilities originally developed for expert artificial intelligence systems. Like other DSS generators, it provides a set of tools for building, running, and documenting mathematical models of business activities. Beyond that, however, the system includes explicit differentiation between hard facts and softer information such as assumptions and expectations, a set of procedures for evaluating and explaining results, and a natural language user interface. In this paper, we discuss the representation of knowledge in ROME and show how it is used to answer questions, explain trends, detect anomalous values, and assess the credibility of model assumptions. GRA

N86-30412# Sandia National Labs., Albuquerque, N. Mex.

SENSOR DRIVEN ROBOT SYSTEMS TESTBED

R. W. Harrigan 1986 18 p Presented at the SPIE Technical Symposium on Applications of Artificial Intelligence, Orlando, Fla., 31 Mar. 1986

(Contract DE-AC04-76DP-00789)

(DE86-005892; SAND-85-2032C; CONF-860366-1) Avail: NTIS HC A02/MF A01

Intelligent robot systems which operate in a semiautonomous fashion (i.e., the operator serves only as a high level supervisor) require the integration of sensors and mechanisms coupled by intelligent software. Since robot systems operate in the real world with imperfect knowledge of that world, error recovery is an important aspect of any control strategy. Configured with a 6 degree-of-freedom robot manipulator, two dimensional vision and force sensing, the Sensor Driven Robot Systems Testbed offers an environment for the development of control concepts for intelligent machine systems. The Sensor Driven Robot Systems Testbed has led to the development of active sensing concepts using complementary sensors and a highly modular control software concept. Both concepts are currently being implemented within the testbed environment. DOE

N86-30413# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. d'Informatique.

APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNIQUES TO FAULT DIAGNOSIS FOR PRINTED CIRCUITS Ph.D. Thesis [APPLICATION DES TECHNIQUES DE L'INTELLIGENCE ARTIFICIELLE AU DIAGNOSTIC DE DEFAUTS DES CIRCUITS IMPRIMES]

Eric Barrielle Dec. 1985 131 p Partly in FRENCH and ENGLISH

(ENST-85E011; ISSN-0751-1353; ESA-86-97215) Avail: NTIS HC A07/MF A01

A fault diagnosis system based on a Prolog language is described. Artificial intelligence languages are discussed in order to justify the choice. The system is composed of five experts dealing with successive tasks: a manager task, a how to look at the problem task, a measurement choice task, a measurement and fault location task, and a last task to verify the diagnosis. A logics printed circuit can be seen as an oriented graph whose components are strongly connected. A program development subsystem is used to interpret the rules and to verify the interface between the manager and the expert. The advantages derived from the use of Prolog are emphasized. Simplicity and efficiency are claimed. ESA

N86-30414# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.

APPLICATION OF INPUT SIGNAL DESIGN IN SYSTEM IDENTIFICATION FOR ADAPTIVE CONTROL

A. Krolikowski Sep. 1984 32 p

(ER-84/04; ESA-86-97524) Avail: NTIS HC A03/MF A01

An approach to the dual control problem, based on the heuristic combination of the input signal design (probing action) with the suboptimal adaptive control algorithm (control action) is proposed. The computation of the probing inputs requires no additional effort so the overall algorithm is easy to implement, and consistent computationally. The algorithm seems to be especially appealing in the case of a short control horizon, high noise level, and for a large uncertainty associated with the unknown system parameters. The crucial problem remains how to choose the probing action length, the amplitude constraint, and the learning parameter in the case of the active adaptive control algorithm. ESA

N86-30415# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.

ADAPTIVE CONTROL OF FIRST-ORDER SYSTEMS WITH TIME-DELAY

A. Krolikowski Oct. 1984 11 p

(ER-84/05; ESA-86-97525) Avail: NTIS HC A02/MF A01

An infinite horizon control problem of a linear discrete-time, first-order system with time delay is considered. The performance of the control strategy is evaluated by the multistep quadratic loss function. In the case of known system parameters, the optimal input is shown to be a simple saturation of the minimum variance control input. In the case of unknown system parameters, an adaptive control algorithm based on the recursive maximum likelihood estimation procedure is presented. Simulation results for various magnitudes of the amplitude constraint are given. ESA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N86-30416 Technische Hogeschool, Eindhoven (Netherlands). Onderafdel. der Wiskunde en Informatica.

ITERATIVE METHODS FOR NONDEFINITE SYMMETRIC SYSTEMS, WITH APPLICATION TO A DISCRETE STOKES PROBLEM [ITERATIVE METHODEN VOOR NIET-DEFINIETE SYMMETRISCHE STELSELS, MET TOEPASSING OP EEN GEDISCRETIS EERD STOKES PROBLEEM]

P. G. M. Penders Sep. 1984 121 p In DUTCH

(ESA-86-97548) Avail: Issuing Activity

The solution of indefinite symmetric linear systems in matrix form is discussed. The finite element method was applied to a Stokes problem in two dimensions. The resulting linear system was resolved by reduction to a series of positive definite problems. An algorithm was constructed to resolve the stated problem using an incomplete Cholesky factorization and a preconditioned conjugate gradient method. An error analysis concerning the constructed algorithm is given. Numerical results of examples tested are given. ESA

N86-30417*# Texas Technological Univ., Lubbock.

APPROXIMATIONS OF NONLINEAR SYSTEMS HAVING OUTPUTS

L. R. Hunt and Renjeng Su 1985 24 p
(Grants NAG2-189; NAG2-203; Contract N000014-76-C-1136)
(NASA-CR-176946; NAS 1.26:176946) Avail: NTIS HC A02/MF A01 CSCL 12A

For a nonlinear system with output derivative $\dot{x} = f(x)$ and $y = h(x)$, two types of linearizations about a point x(0) in state space are considered. One is the usual Taylor series approximation, and the other is defined by linearizing the appropriate Lie derivatives of the output with respect to f about x(0). The latter is called the obvservation model and appears to be quite natural for observation. It is noted that there is a coordinate system in which these two kinds of linearizations agree. In this coordinate system, a technique to construct an observer is introduced. M.G.

N86-30418# Loughborough Univ. of Technology (England). Dept. of Mathematics.
COUNTING NUMBERS REPRESENTABLE AS SUMS OF TWO SQUARES
P. Shiu Jun. 1984 26 p
(LUT-MR-180) Avail: NTIS HC A03/MF A01

Let W(x) count the number of positive integers not exceeding x that are sums of two squares. The values for W(x) are calculated for $x = 10$ to the k power, $k = 1,2,...,12$. The method is based on that given by E. D. F. Meissel and D. H. Lehmer for the computation of the values for the prime counting function. A reappraisal of the method shows how simple checking procedures can be incorporated into the calculations. Author

N86-30419# Tata Inst. of Fundamental Research, Bombay (India).
GENERATING IDEALS IN POLYNOMIAL RINGS
S. Mandal and A. Roy 1986 11 p
Avail: NTIS HC A02/MF A01

Boratynski proved that if I is an ideal in a polynomial ring k[X sub 1,...,X sub n] over a field k, then I is set-theoretically generated by mu(I/I squared) elements (mu denotes the minimal number of generators). A theorem is presented which extends Boratynski's result in the following way: suppose R = A[X] is a polynomial ring over a noetherian commutative ring A and I is an ideal in R that contains a monic polynomial; then I is set-theoretically generated by mu(I/I squared) elements. It also follows from this that if R = A[X sub 1,...,X sub n,Y sub 1(sup + or - 1),...,Y sub r(sup + or - 1)] and I is an ideal in R such that ht I > or = dim A + 1, then I is set-theoretically generated by mu(I/I squared) elements. In addition, some partial results concerning the question of whether mu(I) = mu(I/I squared) are proved. M.G.

N86-30420*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MULTIGRID METHOD FOR THE EQUILIBRIUM EQUATIONS OF ELASTICITY USING A COMPACT SCHEME Final Report
Shlomo Taasan May 1986 25 p
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178120; NAS 1.26:178120; ICASE-86-23) Avail: NTIS HC A02/MF A01 CSCL 12A

A compact difference scheme is derived for treating the equilibrium equations of elasticity. The scheme is inconsistent and unstable. A multigrid method which takes into account these properties is described. The solution of the discrete equations, up to the level of discretization errors, is obtained by this method in just two multigrid cycles. Author

N86-30421*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A MINIMUM ENTROPY PRINCIPLE IN THE GAS DYNAMICS EQUATIONS Final Report
Eitan Tadmor May 1986 21 p Submitted for publication
(Contracts NAS1-17070; NAS1-18107; DAAG29-85-K-0190; Grant NSF DMS-85-03294)
(NASA-CR-178123; NAS 1.26:178123; ICASE-86-33) Avail: NTIS HC A02/MF A01 CSCL 12A

Let u(x bar,t) be a weak solution of the Euler equations, governing the inviscid polytropic gas dynamics; in addition, u(x bar, t) is assumed to respect the usual entropy conditions connected with the conservative Euler equations. We show that such entropy solutions of the gas dynamics equations satisfy a minimum entropy principle, namely, that the spatial minimum of their specific entropy, (Ess inf s(u(x,t)))/x, is an increasing function of time. This principle equally applies to discrete approximations of the Euler equations such as the Godunov-type and Lax-Friedrichs schemes. Our derivation of this minimum principle makes use of the fact that there is a family of generalized entrophy functions connected with the conservative Euler equations. Author

N86-30422*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CONVENIENT STABILITY CRITERIA FOR DIFFERENCE APPROXIMATIONS OF HYPERBOLIC INITIAL-BOUNDARY VALUE PROBLEMS Final Report
Moshe Goldberg (Technion - Israel Inst. of Tech., Haifa.) and Eitan Tadmor (Tel-Aviv Univ., Israel.) Jun. 1986 39 p Submitted for publication
(Contracts NAS1-17070; NAS1-18107; DAAG29-85-K-0190; Grants AF-AFOSR-0150-83; NSF DMS-85-03294)
(NASA-CR-178134; NAS 1.26:178134; ICASE-86-44) Avail: NTIS HC A03/MF A01 CSCL 12A

The purpose of this paper is to achieve more versatile, convenient stability criteria for a wide class of finite-difference approximations to initial boundary value problems associated with the hyperbolic system u sub t = au sub x + Bu + f in the quarter-plane x greater than or equal to 0, t greater than or equal to 0. With these criteria, stability is easily established for a large number of examples, thus incorporating and generalizing many of the cases studied in recent literature. Author

N86-30423*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON COMPACTNESS OF ADMISSIBLE PARAMETER SETS: CONVERGENCE AND STABILITY IN INVERSE PROBLEMS FOR DISTRIBUTED PARAMETER SYSTEMS Final Report
H. T. Banks (Brown Univ., Providence, R. I.) and D. W. Iles Jun. 1986 17 p Presented at the Conference on Control Systems Governed by Partial Differential Equations, Gainesville, Fla., 3-6 Feb. 1986
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178128; NAS 1.26:178128; ICASE-86-38) Avail: NTIS HC A02/MF A01 CSCL 12A

A series of numerical examples is reported and several algorithms compared for estimation of coefficients in differential equation models. Unconstrained, constrained and Tikhonov regularization methods are tested for their behavior with regard to both convergence (of approximation methods for the states and parameters) and stability (continuity of the estimates with respect to perturbations in the data or observed states). Author

N86-30424*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ESTIMATION OF DISCONTINUOUS COEFFICIENTS AND BOUNDARY PARAMETERS FOR HYPERBOLIC SYSTEMS Final Report
Patricia K. Lamm (Southern Methodist Univ., Dallas, Tex.) and Katherine A. Murphy (Brown Univ., Providence, R. I.) Jun. 1986 40 p
(Contracts NAS1-17070; NAS1-18107; Grants NSF DMS-82-00883; NSF DMS-82-05355; NSF DMS-85-04316; AF-AFOSR-0398-84)
(NASA-CR-178133; NAS 1.26:178133; ICASE-86-43) Avail: NTIS HC A03/MF A01 CSCL 12A

The problem of estimating discontinuous coefficients, including locations of discontinuities, that occur in second order hyperbolic systems typical of those arising in 1-D surface seismic problems is discussed. In addition, the problem of identifying unknown parameters that appear in boundary conditions for the system is treated. A spline-based approximation theory is presented, together with related convergence findings and representative numerical examples. Author

N86-30425*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON SUBSTRUCTURING ALGORITHMS AND SOLUTION TECHNIQUES FOR THE NUMERICAL APPROXIMATION OF PARTIAL DIFFERENTIAL EQUATIONS
M. D. Gunzburger (Carnegie-Mellon Univ., Pittsburgh, Pa.) and R. A. Nicolaides May 1986 32 p
(Contracts NAS1-18107; CDAAG-29-83-4-0084; Grants AF-AFOSR-0101-83; AF-AFOSR-0231-83)
(NASA-CR-178122; ICASE-86-30; NAS 1.26:178122) Avail: NTIS HC A03/MF A01 CSCL 12A

Substructuring methods are in common use in mechanics problems where typically the associated linear systems of algebraic equations are positive definite. Here these methods are extended to problems which lead to nonpositive definite, nonsymmetric matrices. The extension is based on an algorithm which carries out the block Gauss elimination procedure without the need for interchanges even when a pivot matrix is singular. Examples are provided wherein the method is used in connection with finite element solutions of the stationary Stokes equations and the Helmholtz equation, and dual methods for second-order elliptic equations. Author

N86-30426*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE EXPANDED LAGRANGIAN SYSTEM FOR CONSTRAINED OPTIMIZATION PROBLEMS
Aubrey B. Poore (Colorado State Univ., Fort Collins.) Jul. 1986 30 p
(Contract NAS1-18107; Grants NSF DMS-85-10201; AFOSR-ISSA-85-00079)
(NASA-CR-178142; ICASE-86-47; NAS 1.26:178142) Avail: NTIS HC A03/MF A01 CSCL 12A

Smooth penalty functions can be combined with numerical continuation/bifurcation techniques to produce a class of robust and fast algorithms for constrainted optimization problems. The key to the development of these algorithms is the Expanded Lagrangian System which is derived and analyzed in this work. This parameterized system of nonlinear equations contains the penalty path as a solution, provides a smooth homotopy into the first-order necessary conditions, and yields a global optimization technique. Furthermore, the inevitable ill-conditioning present in a sequential optimization algorithm is removed for three penalty methods: the quadratic penalty function for equality constraints, and the logarithmic barrier function (an interior method) and the quadratic loss function (an interior method) for inequality constraints. Although these techniques apply to optimization in general and to linear and nonlinear programming, calculus of variations, optimal control and parameter identification in particular, the development is primarily within the context of nonlinear programming. Author

N86-30427*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PRECONDITIONING FOR FIRST-ORDER SPECTRAL DISCRETIZATION
Craig L. Streett and Michele G. Macaraeg Aug. 1986 25 p
(NASA-TM-87619; NAS 1.15:87619) Avail: NTIS HC A02/MF A01 CSCL 12A

Efficient solution of the equations from spectral discretizations is essential if the high-order accuracy of these methods is to be realized. Direct solution of these equations is rarely feasible, thus iterative techniques are required. A preconditioning scheme for first-order Chebyshev collocation operators is proposed herein, in which the central finite difference mesh is finer than the collocation mesh. Details of the proper techniques for transferring information between the meshes are given here, and the scheme is analyzed by examination of the eigenvalue spectra of the preconditioned operators. The effect of artificial viscosity required in the inversion of the finite difference operator is examined. A second preconditioning scheme, involving a high-order upwind finite difference operator of the van Leer type is also analyzed to provide a comparison with the present scheme. Finally, the performance of the present scheme is verified by application to several test problems. Author

N86-30428# Iowa State Univ. of Science and Technology, Ames.
CONFIDENCE REGIONS FOR VARIANCE COMPONENTS IN UNBALANCED MIXED LINEAR MODELS
Alan P. Fenech and David A. Harville Jan. 1986 30 p
(Contract N00014-85-K-0418)
(AD-A165841; PREPRINT-SER-86-12) Avail: NTIS HC A03/MF A01 CSCL 12/1

A general procedure for obtaining exact confidence regions for the variance components in unbalanced mixed linear models is presented. The procedure utilizes, as pivotal quantities, quadratic forms that may depend on the variance components in a complicated way and that are distributed independently as chi-square variates. In the special case of balanced classificatory models, the pivotal quantities simplify to scalar multiples of sums of squares from the usual analysis of variance. The procedure can be easily modified so as to obtain an exact confidence region for ratios of variance components and can be regarded as a generalization of Waid's procedure for obtaining a confidence interval for a single variance ratio. Author (GRA)

N86-30429# Naval Postgraduate School, Monterey, Calif.
PRELIMINARY INVESTIGATION OF A CALCULUS OF FUNCTIONAL DIFFERENCES: FIXED DIFFERENCES
Bruce J. MacLennan Feb. 1986 28 p
(AD-A165879; NPS52-86-010) Avail: NTIS HC A03/MF A01 CSCL 12/1

This document introduces a notion of functional differences in which the difference of a function f with respect to a function h is that function g that describes how the value of f changes when its argument is altered by h: f(h x) = g(f x). It also introduce the inverse operation of functional integration and derive useful properties of both operations. The result is a calculus that facilitates derivation and reasoning about recursive programs. This is illustrated in a number of simple examples. The author presents preliminary results pertaining to fixed differences, that is, functional differences that do not depend on the value of the argument x. Author (GRA)

N86-30430# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
WALSH-FOURIER ANALYSIS OF DISCRETE-VALUED TIME SERIES
David S. Stoffer Nov. 1985 45 p
(Contract F49620-85-C-0008)
(AD-A166139; TR-85-46; AFOSR-86-0064TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

An approach to the analyses of discrete-valued time series is discussed. The analyses are accomplished in the spectral domain using the Walsh-Fourier transform which is based on Walsh functions. This approach will enable an investigator of discrete systems to analyze the data in terms of square-waveforms and sequency rather than sine-waves and frequency. This document develops a general signal-plus-noise type model for discrete-valued time series in which Walsh-Fourier spectral analysis is of interest. The author considers the problems of detecting whether or not a common signal exists in repeated measures on discrete-valued time series and in discrete-valued processes collected in an experimental design. It is shown that these models may depend on unknown regression parameters and consistent estimates of these parameters based on the finite Walsh-Fourier transform are developed. Applications to certain Markov models are given, however, the methods presented also apply to non-Markov cases. Author (GRA)

N86-30431# Kent State Univ., Ohio.
INVESTIGATIONS ON IMPROVED ITERATIVE METHODS FOR SOLVING SPARSE SYSTEMS OF LINEAR EQUATIONS Final Report, 1 Jul. 1981 - 30 Jun. 1984
Richard S. Varga Nov. 1985 16 p
(Grant AF-AFOSR-0226-80)

(AD-A166170; AFOSR-86-0027TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The research conducted under this effort was centered about general matrix methods and applications of matrix theory in solving large systems of linear equations. In particular, the classification of certain factorizations of M matrices was undertaken. An extension of the Stein-Rosenberg theorem comparing the spectral radii of matrices useful in constructing iterative solution techniques was obtained. The use of summability methods and approximated conformal mapping techniques in the study of iterative methods was pursued. Finally, a study of SOR and SSOR iterative methods was accomplished using the theory of H matrices. Eleven papers appeared in the referred literature during this effort. GRA

N86-30432# Johns Hopkins Univ., Baltimore, Md. Dept. of Mathematical Sciences.

STATE ESTIMATION FOR COX PROCESSES WITH UNKNOWN LAW: PARAMETRIC MODELS

Alan F. Karr Nov. 1985 18 p

(AD-A166179; AFOSR-86-0020TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Let (N sub i, M sub i) be i.i.d. copies of a Cox pair (N,M), with the Cox processes N sub i, but not the directing measures M Sub i, observable. Suppose that the probability law of (N,M) belongs to a finite-dimensional parametric family sub theta but is otherwise unknown. Approximations are derived for state estimators. Under standard smoothness and requlrity assumptions n times the difference between the true and pseduo-state estimators converges in distribution to a Gaussian random measure, with respect to the variation norm topology. Computation of maximum likelihood estimators by the EM algorithm is discussed in general and for two specific examples. GRA

N86-30433# Brown Univ., Providence, R. I. Center for Dynamical Systems.

ANALYSIS OF DYNAMICAL SYSTEMS Report, 1 Sep. 1984 - 31 Aug. 1985

Jack K. Hale 5 Dec. 1985 8 p

(Grant AF-AFOSR-0376-84)

(AD-A166224; AFOSR-86-0068TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This research involves extensive studying of the problem of transverse homoclinic orbits of periodic orbits of functional differential equations (FDE's), and also systems of reaction diffusion equations and attempting to understand the effects of boundary conditions on the flow when the diffusion coefficients and the boundary conditions are varied. GRA

N86-30434# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.

ASYMPTOTIC METHODS FOR THE ANALYSIS, ESTIMATION AND CONTROL OF STOCHASTIC DYNAMIC SYSTEMS Annual Report, 11 Nov. 1984 - 10 Nov. 1985

Alan S. Willsky and George C. Verghese 4 Dec. 1985 26 p

(Grant AF-AFOSR-0258-82)

(AD-A166234; LIDS-SR-1516; AFOSR-86-0026TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The basic scope of this grant is to carry out fundamental research in the analysis, control, and estimation of complex systems, with particular emphasis on the use of methods of asymptotic analysis and multiple time scales to decompose complex problems into interconnections of simpler ones. During the time period covered by this report, significant progress had been made in several areas, leading to important results and to promising direction for further research. The Specific topics covered in this report are: 1) Analysis and Estimation for Finite-State and Hybrid Processes Possessing Time or Spatial Decompositions; 2) Analysis and control of Singularly Perturbed and Weakly Coupled Linear Systems; and 3) Analysis and Estimation for Singular Systems. GRA

N86-30435# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE ISOMORPHISM BETWEEN GAUGE GROUPS BEFORE AND AFTER RENORMALIZATION IN THE PRESENCE OF ABEL SUBGROUPS AND HIGGS FIELDS

Rong Wang 14 Mar. 1986 26 p Transl. into ENGLISH from Wuli Xuebao (China), v. 30, no. 6, Jun. 1981 p 731-746

(AD-A166276; FTD-ID(RS)T-0049-86) Avail: NTIS HC A03/MF A01 CSCL 12/1

We give a rigorous proof on the isomorphism between gauge groups before and after renormalization, in the presence of Abel subgroups and Higgs fields. GRA

N86-30436# Naval Postgraduate School, Monterey, Calif.

ROBUST EMPIRICAL BAYES ANALYSES OF EVENT RATES

Donald P. Gaver and Iognaid G. OMuircheartaigh Mar. 1986 56 p

(AD-A166681; NPS55-86-007) Avail: NTIS HC A04/MF A01 CSCL 12/1

A number, I, of nominally similar items generate events (e.g., failures) at possibly different rates, or mean time intervals. This paper addresses the problem of appropriately pooling the data from the different sources. The approach is parametric empirical Bayes: true individual item rates are assumed to come from a fixed superpopulation. It is shown how parameters of a superpopulation model can be estimated from all of the data, and combined with individual unit history, can provide improved estimates of individual rates. The procedure can be robust: evidence that a particular rate is far off from the main body of rates permits that outlier to stand by itself, i.e., to resist pooling. Illustrative analyses of data are supplied. GRA

N86-30437# Naval Weapons Center, China Lake, Calif.

THE OUTPUT OF LINEAR SYSTEMS TO QUASIPOLYNOMIAL INPUTS Final Report, 1983 - 1985

J. M. Martin and G. A. Hewer Sep. 1985 41 p

(AD-A166740; AD-E900546; NWC-TP-6666) Avail: NTIS HC A03/MF A01 CSCL 12/1

The purpose of this report is to summarize some of our joint research on zeros of multivariable linear control systems. This report unifies the many diverse results found in the open literature. It also corrects and generalizes some of the misleading incorrect results found there. This report serves as a basis for subsequent publications and as a guide for applications. GRA

N86-30438# Central Inst. of Physics, Bucharest (Rumania).

PIECEWISE ANALYTICAL PERTURBATION SERIES METHODS FOR SOLVING LINEAR ORDINARY DIFFERENTIAL EQUATIONS. PART 2: THE RADIAL SCHROEDINGER EQUATIONS

Gh. Adam Dec. 1984 44 p

(DE86-700606; IFIN-FT-257-1984-Pt-2) Avail: NTIS (US Sales Only) HC A03/MF A01

The general scheme established in the previous paper for the efficient use of piecewise analytical perturbation series (PAPS) methods to solve linear ordinary differential equations is applied to the radial Schroedinger equation. Starting with a step function approximation to the potential, four optimal PAPS algorithms are written down which show orders of accuracy equal respectively to two, four, six and eight. A comparison with previously published methods in this class illustrates the importance of the optimal choice of the various parameters which enter the PAPS algorithms (approximation of the potential, keeping into the algorithm relevant terms only, adequate difinition of the finite basis set of functions in terms of which the algorithm is expressed). A comparison with the Numerov method in its summed form (which is the most stable version with respect to round off) illustrates the significantly better performances of the optimal sixth order PAPS algorithns. DOE

N86-30439# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.

A FAST, TREE-BASED ACCESS METHOD

Wiebren deJonge, Andrew S. Tanenbaum, and Reind P. vandRiet Mar. 1984 32 p

(Grant ZWO-62-139)

(IR-85; ESA-86-97321) Avail: NTIS HC A03/MF A01

A highly compact representation of binary trees is presented. It is shown how these compact binary trees can be used to represent separators efficiently. The fanout, and thus performance, of a B-tree can be improved by using the method within each index page for representing separators. An index organization, slightly different from a B-tree, that offers another improvement is outlined. The result is a fast, tree-based access method for dynamic files. The idea behind the compact binary trees can be employed for representing pictures and quadtrees compactly. ESA

N86-30440# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
DIMENSION OF BINARY CONVEX STRUCTURES
M. vandeVel Mar. 1984 40 p
(IR-226; ESA-86-97325) Avail: NTIS HC A03/MF A01

It is shown that for compact spaces with a normal binary convexity, the dimension functions dim, ind, Ind, and cohomological dimension are all equal. An n-dimensional compact space X with a normal binary convexity embeds in a product of an n-dimensional connected quotient of X with the space of X-components. Both results are obtained with an auxiliary theory of convex dimension. Applications to completely distributive lattices are given. ESA

N86-30441# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
CONTINUITY OF CONVEXITY PRESERVING FUNCTIONS
M. vandeVel Mar. 1984 23 p
(IR-237; ESA-86-97328) Avail: NTIS HC A02/MF A01

A result of Shirley and Stralka (1971) on the continuity of surjective homomorphisms between finite dimensional lattices is extended to binary convex structures and convexity preserving surjections, and this extension also applies to trees. An additional condition for the finite dimensional case is presented. Similarities with vector spaces lead to the formulation of a general problem. ESA

N86-30442# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
ON MODERATE AND LARGE DEVIATIONS IN MULTINOMIAL DISTRIBUTIONS
Wilbert C. M. Kallenburg May 1984 28 p
(IR-242; ESA-86-97332) Avail: NTIS HC A03/MF A01

Moderate and large deviation theorems for the likelihood ratio statistic and the chi-square statistic in multinomial distributions are presented. Let k be the number of parameters and n the number of observations. Moderate and large deviation theorems are available in literature only if k is kept fixed when n tends to infinity. Although attention is focussed on $k = k(n)$ as n tends to infinity explicit inequalities are obtained for k and n fixed. These inequalities imply results for the whole scope of moderate and large deviations for fixed k and for k (n) tends to infinity as n tends to infinity. It turns out that the Chi-squared approximation continues to hold, even if k tends to infinity. Applications include the study of the influence of the choice of the number of classes on the power in goodness of fit tests. ESA

N86-30443# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
A CODIMENSION TWO BIFURCATION WITH A THIRD ORDER PICARD-FUCHS EQUATION
R. Cushman and J. A. Sanders Mar. 1984 23 p
(IR-249; ESA-86-97338) Avail: NTIS HC A02/MF A01

Using a third order Picard-Fuchs equation, it is shown that a certain two parameter family of planar vector fields for parameter values in a certain cone has a unique limit cycle, which is born from a Hopf bifurcation and dies in a saddle connection. This removes a superfluous hypothesis in Theorem 3.2, Chapter 13 of Chow and Hale (1982). ESA

N86-30444# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
ONE-PARAMETER FAMILIES OF OPTIMIZATION PROBLEMS: EQUALITY CONSTRAINTS Thesis
H. Th. Jongen, P. Jonker, and F. Twilt 25 Feb. 1986 26 p Submitted for publication
(ESA-86-97357) Avail: NTIS HC A03/MF A01

Generalized critical points are introduced and their relationship with other concepts of critical and stationary points is discussed. Under generic regularity conditions, the set of generalized critical points, in particular the change of the Morse index is studied. Problems with equality constraints only are considered. Extending the theory to problems with inequality constraints is indicated.ESA

N86-30445# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
THE ESTIMATION OF MINIMAL POLYNOMIAL COEFFICIENTS AND A START SEQUENCE OF MARKOV PARAMETERS M.S. Thesis
J. L. J. M. vanderWeijden Sep. 1984 101 p
(ESA-86-97519) Avail: NTIS HC A06/MF A01

Two least-squares methods for estimating the minimal polynomial coefficients and the start sequence of Markov parameters are presented. The first method tries to find the minimum of a quadratic loss function (being the squared distance of the estimated Markov parameters to the available noise corrupted set of parameters) by an iteration process. The second algorithm uses a hill climbing procedure to find the optimum of the error function (in this case the squares of the differences between the estimated output signals and the measured signals). Both procedures are compared with each other and with an explicit iterative algorithm that estimates truncated impulse responses. ESA

N86-30446# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
IDENTIFICATION OF MULTIVARIABLE SYSTEMS AND REPRESENTATION IN CANONICAL AND PSEUDO-CANONICAL FORM M.S. Thesis
P. M. Carriere Nov. 1984 130 p
(ESA-86-97520) Avail: NTIS HC A07/MF A01

The structural and parametric identification of stable, linear, time-invariant, time-discrete, and observable (or controllable) multivariable systems is treated. The structural identification is performed by methods using the determinants ratio and the singular value decomposition. The compensated least squares method, and the instrumental variable method are used to accomplish the parametric identification. The processes are identified in an Input/Output model and from there transformations to represent them in the canonical and pseudo-canonical form of the state space model are performed. ESA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N86-30447*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ASSIST: USER'S MANUAL
Sally C. Johnson Aug. 1986 42 p
(NASA-TM-87735; NAS 1.15:87735) Avail: NTIS HC A03/MF A01 CSCL 12A

Semi-Markov models can be used to compute the reliability of virtually any fault-tolerant system. However, the process of delineating all of the states and transitions in a model of a complex system can be devastingly tedious and error-prone. The ASSIST program allows the user to describe the semi-Markov model in a high-level language. Instead of specifying the individual states of the model, the user specifies the rules governing the behavior of the system and these are used by ASSIST to automatically generate the model. The ASSIST program is described and illustrated by examples. Author

N86-30448# George Mason Univ., Fairfax, Va. Dept. of Systems Engineering.
MATHEMATICAL AND STATISTICAL CHARACTERIZATIONS

OF GENERALIZED HYPEREXPONENTIAL DISTRIBUTION FUNCTIONS
Robert F. Botta, Carl M. Harris, and William G. Marchal Feb. 1986 46 p
(Contract N00014-86-K-0029)
(AD-A165892; GMU/49146/101) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper examines in detail the class of generalized hyperexponential (GH) probability distribution functions. The family is compared to and contrasted with similar popular classes of distributions used in stochastic modeling. Each of these families arises from a desire to preserve the computationally attractive feature of memorylessness possessed by the exponential probability distribution while extending the representations to a broader class in order to approximate an arbitrary probability distribution function. Thus, the simple structure and attractive properties of the GH probability distribution functions are presented with a view toward facilitating the mathematical operations which frequently occur in practice. Author (GRA)

N86-30449# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
SELECTING THE BEST POPULATION, A DECISION THEORETIC APPROACH: THE CASE OF PARETO DISTRIBUTION
N. Dailami (Sheffield Univ., England.), K. Subramanyam, and M. B. Rao Nov. 1985 36 p
(Contract F49620-85-C-0008)
(AD-A166152; TR-85-41; AFOSR-86-0061TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The main ideas in selecting the best populations meeting some prescribed optimality criterion have been mooted originally by Bechchofer and Gupta and the subject has gone from strength to strength by several contributions by several statisticians over the last three decades. In this paper, the selection problem is tackled from a decision theoretic point of view. In selecting the best population, we take into account the cost of sampling and the penalties for taking a wrong decision. We are basically interested in selecting the best Pareto population following the lead given by Somerville and Ofosu. The Pareto proposed this model to study the distribution of incomes in various societies for comparison. In medical circles, this has been used as a model for the remission rate of discharged psychiatric patients as a survival model for cardiac patients waiting for a heart transplant operation. This paper considers four different types of penalty functions including the one considered by Ofosu. Under three of these penalty function we derive the minimax sample sizes. The maximum of the resultant loss function is explicitly derived overcoming the difficulty faced by Ofosu. GRA

N86-30450# Pittsburgh Univ., Pa. Center for Multivariate Analysis.
EXPONENTIAL BOUNDS OF MEAN ERROR FOR THE NEAREST NEIGHBOR ESTIMATES OF REGRESSION FUNCTIONS
L. C. Zhao Nov. 1985 17 p
(Contract F49620-85-C-0008)
(AD-A166156; TR-85-44; AFOSR-86-0065TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper establishes an expontential bound of the mean deviation between m sub n (x) and m (x) given the training sample z subn = (x sub 1), ...,X sub n, under the conditions as weak as possible. This is a substantial improvement on Beck's results. GRA

N86-30451# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
THE NUMBER OF CLASSES IN CHI-SQUARE GOODNESS OF FIT TESTS
W. C. M. Kallenberg and J. Oosterhoff Mar. 1984 45 p
(IR-246; ESA-86-97336) Avail: NTIS HC A03/MF A01

The power of chi-square goodness of fit tests based on different partitions is studied by considering contamination and exponential families of densities between the null density and fixed alternative densities. For sample sizes n tends to infinity, local asymptotic theory with respect to the number of classes k is developed for such families. Simple sufficient and almost necessary conditions under which it is asymptotically optimal to let k tend to infinity with n are derived. A numerical study shows that the results of the asymptotic local theory for contamination families agree well with power performance of chi-square tests. For heavy-tailed alternatives these tests have the best power when k is relatively large. Unbalanced partitions with small classes in the tails perform surprisingly well, particularly when the alternatives have fairly heavy tails. ESA

N86-30452# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
A SIMPLE EXAMPLE WHERE THE JACKNIFE FAILS
W. C. M. Kallenberg May 1984 11 p
(IR-256; ESA-86-97344) Avail: NTIS HC A02/MF A01

An example where the jacknife procedure fails in reducing the bias of the maximum likelihood estimator is presented. By considering an asymptotically equivalent, yet easier, estimating problem in terms of Bernoulli random variables it is shown why straightforward application of the jacknife procedure fails, and how bias reduction can be obtained by application of the jacknife procedure on the right statistic. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N86-30453# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
USE OF A VIRTUAL CONTROL APPROACH IN STATE ESTIMATION
A. T. Fleury and A. Rios-Neto May 1986 21 p Proposed for presentation at the 10th World IFAC Congress, Munich, West Germany, 26-31 Jul. 1987
(INPE-3903-PRE/944) Avail: NTIS HC A02/MF A01

This work presents the development of a state estimator for dynamic systems and explores the dual function existing between state estimation and optimal control problems. An estimator algorithm similar to the Extended Kalman Filter can be used in real-time nonlinear systems which can be recursively approximated by linear systems. The original estimation problem is transformed into an equivalent one of virtual control. This control problem is then used to generate and adaptive, locally convergent algorithm where, instead of full state estimation, one has to estimate just a control vector with smaller dimension than the state vector. The control formulation also allows the development of convergence acceleration criteria. The algorithms are implemented in a digital computer to estimate the orbit of a low Earth orbit satellite under simulated conditions. Numerical results are presented for a test case considering critical initial values for the estimator and observations provided by three Earth stations. Author

N86-30454# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Ministerio da Ciencia e Technologia.
CONTROL OF NONLINEAR SYSTEMS USING FIXED POINT THEOREMS
J. A. M. FelippeDeSouza Jun. 1986 14 p Proposed for presentation at the 10th World IFAC Congress, Munich, West Germany, 26-31 Jul. 1987
(INPE-3923-PRE/957) Avail: NTIS HC A02/MF A01

Several fixed point techniques used in control of nonlinear systems are discussed. These techniques consider a space of functions U as the set of admissible functions. Some new techniques which allow cases where the set of admissible functions U sub ad is a bounded, closed and convex subset of U are also presented. The semigroup approach is used so that distributed parameter systems are considered. A brief discussion on the

various types of fixed point theorems are given, as well as some references. Author

N86-30455# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STATE ESTIMATION AND PARAMETER IDENTIFICATION OF LINEAR AND SEMILINEAR DISTRIBUTED PARAMETER SYSTEMS
J. A. M. FelippeDeSouza and A. J. Pritchard May 1986 8 p Presented at the 2d conference on Telecommunication and Control, Rio de Janeiro, Brazil, 10-13 Dec. 1985
(INPE-3904-PRE/945) Avail: NTIS HC A02/MF A01

Some results are presented for the joint problem of state estimation and parameter identification of linear systems of the type: z = Az + A sub 1 alpha, z(0) = z sub zero, and semilinear systems of the type: z = Az + A sub 1 Alpha + N(z,a), z(0) = z sub zero, where A and A sub 1 are linear operators and N is nonlinear operator defined on an appropriate Banach space Z, the state space, and are dependent on the parameter alpha epsilon IR superscript p to be identified. The initial state z sub zero is unknown. The observation process is described by: y = Cz, where C is a linear operator from Z to Y (output space). It is assumed that the dynamics of the linear part can be described in terms of a strongly continuous semigroup on Z, so that this formulation includes distributed parameter systems and delay systems as well as lumped parameter system. Author

N86-30456# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Ministerio da Ciencia e Tecnologia.
STATE ESTIMATION AND PARAMETER IDENTIFICATION FOR SEMILINEAR DISTRIBUTED PARAMETER SYSTEMS
J. A. M. FelippeDeSouza Jun. 1986 8 p Presented at the 6th Conference on Automatic Control, Belo Horizonte, Brazil, 25-28 Nov. 1986
(INPE-3932-PRE/964) Avail: NTIS HC A02/MF A01

The problem is considered of state estimation and parameter identification of semilinear systems of the type derivitive z=Az+Nz (A=A(alpha) linear, N (alpha) nonlinear, alpha and R sup P being the p parameters to be identified) with an observation y = Cz (C linear). It is assumed that the dynamic of the linear part (i.e., derivitive z = Az) can be described in terms of a strongly continuous semigroup on an appropriate Banach space Z, so that this formulation includes distributed parameter systems and delay systems as well as lumped parameter systems. First of all we develop some theoretical results by using fixed point theorems with some mappings F:X yields X, where X is a space of functions from the interval (O,T) to Z (the possible trajectories of the system). However, these results are obtained by imposing some conditions on the space of output functions, which restrict the class of systems studied. Therefore we also consider an approach involving the pair (z sub 0,z(.)) consisting of the initial state and the trajectory in a space M which is the cross product Z x X between the state space Z and the space of trajectories X. We show that the solution of the problems of state estimation and parameter identification can be obtained via the fixed point of a variety of maps F:M yields M. Author

N86-30457# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Ministerio da Ciencia e Tecnologia.
CONTROL OF NONLINEAR DISTRIBUTED PARAMETER SYSTEMS USING FIXED POINT TECHNIQUES
J. A. M. FelippedeSouza Jun. 1986 8 p Presented at the 9th Congresso Nacional de Matematica Aplicada e Computacional, Brasilia, Brazil, 25-29 Aug. 1986
(INPE-3922-PRE/956) Avail: NTIS HC A02/MF A01

Fixed point theorems have been an important tool used by mathematicians in the study of the existence of a solution to nonlinear differential equations, and nonlinear operator equations in general, since the beginning of the century. The present paper discuss the several fixed point techniques used in control of nonlinear systems in papers already published on this subject. The semigroup approach is used so that distributed parameter systems are considered. Author

N86-30458# Naval Postgraduate School, Monterey, Calif.
ON INFERENCE AND TRANSIENT RESPONSE FOR M/G/1 MODELS
Donald P. Gaver and Patrica A. Jacobs Mar. 1986 19 p
(AD-A166578; NPS55-86-006) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper addresses two problems of interest in service system analysis: (a) that of making statistical, data-driven estimates of the long-run probability of a long delay, and (b) the assessment of rate of approach to a long-run system performance measure such as expected delay, the rate being characterized by a simple exponential, at least initially. Both are illustrated by reference to M/G/1 and related systems. Author (GRA)

N86-30459# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Mathematics and Computer Science.
VALID INEQUALITIES FOR MIXED 0-1 PROBLEMS M.S. Thesis
P. W. M. M. Hermans Sep. 1984 87 p
(ESA-86-97305) Avail: NTIS HC A05/MF A01

Mixed zero-one regions which are described by one single inequality, concerning both zero-one variables and continuous variables, and by bounding-restrictions in the continuous variables are considered. Classes of valid linear inequalities (or facets of the underlying polytope) are derived. Given a point that is no element of the underlying polytope, methods to detect such valid linear inequalities (or facets) which are also violated by this point are derived. The detected inequalities (or facets) can be used to strengthen the formulation of mixed zero-one problems, so that, e.g., a branch and bound method, applied to the strengthened formulation, might reach the optimal solution sooner than if the original formulation is used. ESA

N86-30460# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Mathematics and Computer Science.
A NOTE ON THE EVALUATION OF THE MEAN VALUE SCHEME FOR CLOSED MULTICHAIN QUEUEING NETWORKS
Jan vanDoremalen Apr. 1984 9 p
(MEMO-COSOR-84-04; ESA-86-97309) Avail: NTIS HC A02/MF A01

An algorithm for the evaluation of the mean value scheme in closed multichain queueing networks, based on mean value analysis is presented. The algorithm does not involve a nested enumeration of population vectors. It is not very efficient, but implementation is simple. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N86-30461# North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
TAIL BEHAVIOR FOR THE SUPREMA OF GAUSSIAN PROCESSES WITH A VIEW TOWARDS EMPIRICAL PROCESSES Technical Report, Sep. 1985 - Aug. 1986
Robert J. Adler and Gennady Samorodnitsky Nov. 1985 54 p
(Contract F49620-85-C-0144; Grant AF-AFOSR-0104-84)
(AD-A166151; TR-127; AFOSR-86-0015TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

Initially this document considers the standard isonormal linear process L on a Hilbert space H, and applying metric entropy methods obtains bounds for a certain probability. Under the assumption that the entropy function of C grows polynomially, we find bounds of the form where delta squared is the maximal variance of L. We use a notion of entropy finer than that usually employed, and specifically suited to the non-stationary situation. As a result we obtain, in the non-stationary setting, more precise bounds than any in the literature. We then treat a number of examples in which the power alpha is identified. These include the distribution of the maximum of certain locally stationary processes. GRA

N86-30462# Centro Tecnico Aerospacial, San Jose dos Campos (Brazil). Inst. de Estudos Avancados.
COMPUTATIONAL EFFICIENCY STUDY OF A SEMI-ANALYTICAL TECHNIQUE FOR THE ANGULAR INTEGRAL ESTIMATION FOUND IN TRANSFER MATRIX GENERATION
R. D.M. Garcia 1984 10 p In PORTUGUESE
(DE86-700784; CTA-IEAV-NT-011/84) Avail: NTIS (US Sales Only) HC A02/MF A01

The computational efficiency of a semi-analytic technique recently proposed for the evaluation of certain angular integrals encountered in the generalization of the isotropic and linearly anisotropic components of elastic and discrete inelastic transfer matrices is studied. It is concluded from a comparison with results obtained with the use of numerical quadratures that the technique has certain computational advantages that recommend its implementation. DOE

N86-30463# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
CLOSED IMAGES OF TOPOLOGICAL GROUPS
Jan vanMill Mar. 1984 11 p
(IR-243; ESA-86-97333) Avail: NTIS HC A02/MF A01

It is shown that every separable metrizable space is a closed image of a separable metrizable topological group. It is shown that there are homogeneous Borel subsets of IR that are not a perfect image of a topological group. ESA

N86-30464# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
CHEBYSHEV SETS AND CONTINUOUS POSITION
M. vandeVel Mar. 1984 11 p
(IR-245; ESA-86-97335) Avail: NTIS HC A02/MF A01

A subset of a vector space is in continuous position if it satisfies a certain relative closure condition for convex open sets. Every convex set is in continuous position. The converse statement (for closed sets only) leads to a problem which is similar to the Chebyshev set problem. It is shown that a combination of the two conditions leads to the convexity of the given set in a Hilbert space. Results concerning boundedly compact sets in a Banach space, and compact sets in an arbitrary locally convex space are derived. ESA

N86-30465# Vrije Universiteit, Amsterdam (Netherlands). Dept. of Mathematics and Computer Science.
DESCRIPTIVE COMPLEXITY OF FUNCTION SPACES
J. vanMill, D. Lutzer, and R. Pol 6 Feb. 1985 19 p Sponsored in part by Vrije University, Amsterdam, Netherlands
(Grant NSF MCS-80-016617)
(IR-278; ESA-86-97354) Avail: NTIS HC A02/MF A01

It is shown that C pi (X), the set of continuous, real-valued functions on X topologized by the pointwise convergence topology, can have arbitrarily high Borel or projective complexity in R sup X, even when X is a countable regular space with a unique limit point. It is shown how to construct countable regular spaces X for which C pi (X) lies nowhere in the projective hierarchy of the complete separable metric space R sup X. ESA

N86-30466# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
CRITICAL SETS IN PARAMETRIC OPTIMIZATION Thesis
H. Th. Jongen, P. Jonker, and F. Twilt Aug. 1985 36 p Revised Submitted for publication
(ESA-86-97358) Avail: NTIS HC A03/MF A01

The concept of a generalized critical point (gc point) is introduced. Every local minimum, Kuhn-Tucker point, and point of Fritz John type is a gc point. Under fairly weak (even generic) conditions the set consisting of all gc points is studied. Due to the parameter, the set is pieced together from one-dimensional manifolds. The points of the set can be divided into five (characteristic) types. The subset of nondegenerate critical points (first type) is open and dense (nondegenerate means strict complementarity nondegeneracy of the corresponding quadratic form, and linear independence of the gradients of binding constraints). A nondegenerate critical point is completely characterized by four indices. The change of these indices along the set is presented. The Kuhn-Tucker subset is studied in connection with the (failure of the) Mangasarian-Fromowitz constraint qualification. ESA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics.* For astrophysics see *90 Astrophysics.* For solar physics see *92 Solar physics.*

N86-30467# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering and Applied Physics.
FUNDAMENTAL RELATIVISTIC SOLUTION FOR THE RAILGUN Interim Report, Aug. - Dec. 1985
Richard L. Liboff, Gregory K. Schenter, and G. L. Ferrentino (Army Armament Research and Development Command, Dover, N. J.) Apr. 1986 17 p Sponsored in part by Battelle Columbus Labs, Ohio
(Contract DAAG29-81-D-0100)
(AD-A166607; ARFSD-CR-86004) Avail: NTIS HC A02/MF A01 CSCL 20/3

A fully relativistic analysis is made of the dynamics of a railgun based on three assumptions: (1) Ohm's law is valid in the rest frame of the plasma, (2) total electron momentum is transferred to the projectile, and (3) motion of the projectile is constrained to one direction. With these assumptions, a relativistic equation for the velocity of the projectile is obtained whose solution monotonically increases to one of two values depending on field strengths. For B>E, the maximum velocity is cE/B whereas for E>B it is c where c is the speed of light, and E and B are applied electric and magnetic fields, respectively. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environment Pollution.*

N86-30468# Royal Aircraft Establishment, Farnborough (England).
INVESTIGATION OF THE AERODYNAMIC PERFORMANCE AND NOISE CHARACTERISTICS OF A 1/5TH SCALE MODEL OF THE DOWTY ROTOL R212 PROPELLER
W. J. G. Trebble 15 Nov. 1983 35 p
(RAE-TM-AERO-1983; BR90678; ESA-86-97104) Avail: NTIS HC A03/MF A01

The four-bladed Dowty Rotol R212 propeller (NACA 16 sections) was studied at 1/5th scale (0.7 m diameter) in 1.5 m acoustic tunnel. Propeller power absorption and thrust were measured over a range of rotational speeds up to 8000 rev/min at mainstream speeds from 15 to 60 m/sec for a range of blade settings. Slipstream wake surveys show outward movement of the position of the peak pressure as propeller loading is increased. Noise analysis demonstrates the predominance of multiple tones whose number and intensity increase with helical-tip Mach number. An empirical formula shows that the fundamental tone sound pressure level varies with tip speed and power loading in an identical manner to that observed on an ARA-D section propeller. ESA

N86-30469*# PRC Kentron, Inc., Hampton, Va. Aerospace Technologies Div.
NOISE PREDICTIONS OF A HIGH BYPASS TURBOFAN ENGINE USING THE LOCKHEED NEAR-FIELD NOISE PREDICTION PROGRAM
John W. Rawls, Jr. Jul. 1986 71 p
(Contract NAS1-18000)
(NASA-CR-178146; NAS 1.26:178146) Avail: NTIS HC A04/MF A01 CSCL 20A

The prediction of engine noise during cruise using the Near-Field Noise Prediction Program developed by Lockheed is examined. Test conditions were established which simulate the

operation of a high bypass turbofan engine under a wide range of operating conditions. These test conditions include variations in altitude, flight Mach number and thrust setting. Based on the results of noise prediction made using the Lockheed program, an evaluation of the impact of these test conditions on the overall sound pressure level(OASPL)and the one-third octave band spectra is made. An evaluation of the sensitivity of flight condition parameters is also made. The primary noise source from a high bypass turbofan was determined to be fan broadband shock noise. This noise source can be expected to be present during normal cruising conditions. When present, fan broadband shock noise usually dominates at all frequencies and all directivity angles. Other noise sources of importance are broadband shock noise from the primary jet, fan noise, fan mixing noise and turbine noise. Author

N86-30470*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SONIC-BOOM RESEARCH: SELECTED BIBLIOGRAPHY WITH ANNOTATION

Harvey H. Hubbard (Bionetics Corp., Hampton, Va.), Domenic J. Maglieri, and David G. Stephens Sep. 1986 44 p

(NASA-TM-87685; L-16127; NAS 1.15:87685) Avail: NTIS HC A03/MF A01 CSCL 20A

Citations of selected documents are included which represent the state of the art of technology in each of the following subject areas: prediction, measurement, and minimization of steady-flight sonic booms; prediction and measurement of accelerating-flight sonic booms; sonic-boom propagation; the effects of sonic booms on people, communities, structures, animals, birds, and terrain; and sonic-boom simulator technology. Documents are listed in chronological order in each section of the paper, with key documents and associated annotation listed first. The sources are given along with acquisition numbers, when available, to expedite the acquisition of copies of the documents. Author

N86-30471*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

A NEW VERSION OF THE HELICOPTER AURAL DETECTION PROGRAM, ICHIN

Arnold W. Mueller, Charles D. Smith (PRC Kentron, Inc., Hampton, Va.), Kevin P. Shepherd (Bionetics Corp., Hampton, Va.), and Brenda M. Sullivan Jul. 1986 8 p

(NASA-TM-87745; NAS 1.15:87745) Avail: NTIS HC A02/MF A01 CSCL 20A

NASA Langley Research Center personnel have conducted an evaluation of the helicopter aural detection program I Can Hear It Now (ICHIN version-5). This was accomplished using flight noise data of five helicopters, obtained from a joint NASA and U.S. Army acoustics measurement program. The evaluation consisted of presenting the noise data to a jury of 20 subjects and to the ICHIN-5 program. A comparative study was then made of the detection distances determined by the jury and predicted by ICHIN-5. This report presents the changes made in the ICHIN-5 program as a result of this comparative study. The changes represent current psychoacoustics and propagation knowledge. Author

N86-30472# Texas Univ., Austin. Applied Research Lab.

NONLINEAR EFFECTS IN LONG RANGE UNDERWATER ACOUSTIC PROPAGATION

Frederick D. Cotaras 1 Nov. 1985 219 p

(Contracts N00014-75-C-0867; N00014-84-K-0574; DA Proj. RR0-1108)

(AD-A166492; ARL-TR-85-32) Avail: NTIS HC A10/MF A01 CSCL 20/1

This report investigates the propagation of finite amplitude acoustic signals through an inhomogeneous ocean both analytically and numerically. In the numerical study the ocean is assumed to be stratified. The effects of inhomogeneity, ordinary attenuation and dispersion, and nonlinear geometrical acoustics are discussed. Two explosion waveforms are considered: a weak shock with an exponentially decaying tail and a more realistic waveform that includes the first bubble pulse. Numerical propagation of the simpler wave along a 58.1 km path starting at a depth of 300 m leads to the following conclusions: (1) The effect of inhomogeneity on nonlinear distortion is small. (2) Dispersion plays an important role in determining the arrival time of the pulse. (3) Neither nonlinearity nor ordinary attenuation (and dispersion) are paramount; both need to be included. For a more realistic wave, propagation is along a 23 km ray path starting from a depth of 4300 m. Two charge weights, 0.818 kg and 22.7 kg TNT, are assumed. In each case the energy spectrum of the signal obtained by considering finite amplitude effects for the entire 23 km path is compared with spectra obtained by neglecting finite amplitude effects entirely, after the first 150 m, and after the first 1100 m. Finite amplitude effects are of small consequence in the case of the 0.818 kg TNT explosion for frequencies below 6 kHz at distances beyond 1100 m. For the 22.7 kg explosion the corresponding quantities are 4 kHz and 1100 m. GRA

N86-30473# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.

LORENTZ INVARIANCE AND THE ROTOR DOPPLER SHIFT EXPERIMENTS

W. A. RodriguesJunior (Universidade Estadual de Campinas (Brazil).) and J. Tiomno 1984 23 p Prepared in cooperation with Universidade Estadual de Campinas (Brazil). Inst. de Matematica.

(DE86-700614; CBPF-NF-017/84) Avail: NTIS (US Sales Only) HC A02/MF A01

It is shown that rotor doppler shift experiments provide a way to distinguish Einstein's Special Relativity (SR) from Lorentz's Aether Theory (LAT). Misconceptions in previous papers involving the Doppler shift experiments are examined. The theoretical and experimental data available on rotor Doppler shift experiments are analysed. Two models of SR violating theories are used to predict the output of a recently proposed experiment by Torr and Kolen. The first one corresponds to (strict) LAT and the other to an extended form of LAT Contrary to the first, the second theory leads to results in agreement with the preliminary experimental data of Torr et al indicating a breakdown both of SR and strict LAT. DOE

N86-30474# Foersvarets Forskingsansalt, Stockholm (Sweden).

AUDITORY HELICOPTER DETECTION AND LOCALIZATION; A LITERATURE REVIEW FOCUSING ON SEARCH FOR HELICOPTERS

Clemens Weikert Jan. 1986 19 p In SWEDISH; ENGLISH summary

(FOA-C-50033-H2; ISSN-0347-7665; ESA-86-97241) Avail: NTIS HC A02/MF A01

About 300 references on auditory localization were reviewed. Detection of low frequency sound is discussed. Literature shows that man's ability to localize sounds by auditory detection is good. Vision may also assist the auditory localization. A helicopter approaching at a great height (1500 feet) is easier to localize than a low flying one (200 feet), and a helicopter heading into the wind is significantly more difficult to localize than one having the wind astern, even when the wind speed is low. When background conditions are quiet, one may expect to detect a noisy helicopter at a distance over 13 km. ESA

N86-30475# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).

EXPERIMENTAL INVESTIGATION OF RESISTIVE DAMPING ELEMENTS

J. R. Piechna and G. E. A. Meier Jul. 1985 40 p

(MPIS-19/1985; ISSN-0436-1199; ESA-86-97432) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 15

Resistive damping elements for acoustic waves in ducts were investigated. The resistive type elements have the form of splitter plates made from thin resistive material. The resistive elements are located inside circular and rectangular ducts parallel to the main stream. The aerodynamic drag of these elements is relatively

small and the damping efficiency high. Investigations of permeable splitter plates confirm numerical calculations. ESA

N86-30476# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
INFRASOUND FROM DISTANT ROCKET LAUNCHES
G. E. Greene and A. J. Bedard Feb. 1986 25 p
(PB86-182771; NOAA-TM-ERL-WPL-131) Avail: NTIS HC A02/MF A01 CSCL 20N

From 1959 through 1969 low-frequency (0.02-1.0 Hz) acoustic signals related to missile launches from Cape Canaveral were recorded by an infrasonic station in Washington, D.C. Although the characteristics of these signals are considerably more variable than those from other known sources, the acoustic signatures can resemble those from sources both natural and manmade. A general summary includes 61 missile-related signals with specific examples of their features. Author

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N86-30477# Cornell Univ., Ithaca, N.Y. Dept. of Chemistry.
LASER STUDIES OF HALOGENS AND OXYGEN Final Report, 1 Nov. 1984 - 31 Oct. 1985
Paul L. Houston 1 Jan. 1986 6 p
(Contract F49620-83-K-0012)
(AD-A166257; AFOSR-86-0105TR) Avail: NTIS HC A02/MF A01 CSCL 20/5

Interconversions of energy between the metastable species of halogens, interhalogens, and oxygen are important to the determination of the mechanisms for the chemical oxygen/iodine and IF lasers and to the development of a better fundamental understanding of electronic energy transfer. Previous research by our group in this broad area has investigated the kinetics of the equilibrium I* + O2 = I + O2(1 Delta), has measured electronic-to-vibrational energy transfer from I* to I2, and has determined the rates of deactivation of I* by alkyl and perfluoroalkyl iodides. During the past three years our efforts have focused on better ways to detect O2 (1 Delta), on the deactivation kinetics of I* by Cl2, and on the photodisociative generation of iodine atoms. Sensitive detection of O2 (1 Delta by multiphoton ionization is reported. The deactivation of I* by Cl2 is found to be much slower than previously thought. The photodissociation of ICN and CH3I have been examined. The relaxation of I* by alkyliodides and perfluoroalkyliodides is reported. GRA

N86-30478# California Univ., Santa Barbara. Quantum Inst.
MEAN TRAJECTORY GAUSSIAN WAVE PACKET APPROACH TO ROTATIONALLY INELASTIC MOLECULE-SURFACE DIFFRACTION Annual Report
Bret Jackson and Horia Metiu Feb. 1986 42 p
(Contract N00014-81-K-0598)
(AD-A166275; TR-10) Avail: NTIS HC A03/MF A01 CSCL 20/10

The rotationally inelastic diffraction of H2 from a corrugated surface is investigated using a mean trajectory model. The center of mass motion is treated using Gaussian wave packets, which propagate on a rotationally averaged potential. This trajectory in turn drives the rotational transitions. The method is non-perturbative and allows for changes in mj, the rotational orientation, and agrees well with recent close coupling calculations. A connection is also made with the recent semiclassical trajectory work of DePrito. The effects of the attractive well depth on rotational excitation and diffraction are considered. GRA

N86-30479# Wisconsin Univ., Madison. Dept. of Physics.
MOLECULAR REACTION RATES Final Report, 6 Apr. 1982 - 30 Sep. 1985
Chun C. Lin and Sunggi Chung 28 Oct. 1985 59 p
(Contract F19628-82-C-0042)
(AD-A166518; AFGL-TR-85-0262) Avail: NTIS HC A04/MF A01 CSCL 07/4

The energies and wave functions for several series of Rydberg states of the nitrogen molecule have been calculated. Based on these results a long-wave infrared emission spectrum of the nitrogen molecule is predicted. The optical cross sections for exciting a series of atomic oxygen emission lines in the long-wave infrared region by electron impact on oxygen molecules have been obtained. GRA

N86-30480# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
MEASUREMENT OF ABSOLUTE EMISSION CROSS SECTIONS FOR EXTREME ULTRAVIOLET (EUV) PHOTONS IN THERMAL COLLISIONS OF METASTABLE HELIUM (2 SUP 1 S) WITH NEON AND HELIUM Thesis [MESSUNG ABSOLUTER EMISSIONSQUERSCHNITTE FUER EUV-PHOTONEN BEI THERMISCHEN STOESSEN VON METASTABILEM HELIUM (21S) MIT NEON UND HELIUM]
Guenter Hoffmann Jun. 1985 87 p In GERMAN
(MPIS-14/1985; ISSN-0436-1199; ESA-86-96901) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 19

Under single-collision conditions EUV photons emitted in the collision of metastable He with Ne and He-atoms were directly observed in an atomic beam experiment. The EUV emission was measured as a function of collision energy. The emission cross sections were calibrated in absolute units. The method uses the natural decay photons of the free metastable He. Stueckelberg oscillations are resolved in the total cross section with Ne; Close-coupling calculations were performed for the dominant excitation process in He. A comparison between theory and measurements shows three onset thresholds for several photon groups, and the collision dynamics picture is clarified. In the collision system metastable He-He the deexcitation is determined as energy-dependent EUV emission. ESA

N86-30481# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
ORIENTATION EFFECTS AND FINE STRUCTURE TRANSITIONS IN DIFFERENTIAL SCATTERING CROSS SECTIONS Thesis [ORIENTIERUNGSEFFEKTE UND FEINSTRUKTURUEBERGAENGE IN DIFFERENTIELLEN STREUQUERSCHNITTEN]
E. Hasselbrink Jun. 1985 117 p In GERMAN
(MPIS-15/1985; ISSN-0436-1199; ESA-86-96902) Avail: NTIS HC A06/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 25

Theoretical fundamentals of the interaction between alkali and noble gas atoms are explained. The differential cross sections were determined in atomic beam experiments. The atomic beam was excited by a dye laser. A left-right polarization asymmetry was observed in the total differential cross section of the scattering of oriented K and Na-atoms in the first electronically excited state. The fine structures occurring in the asymmetry can be understood as remains of Stueckelberg oscillations. The asymmetry can be understood by the amplitude of the fine structure splitting in relation to the interaction between nuclear motion and electronic angular momentum. The fast oscillations in the total differential scattering cross section of the system K-Ne are determined and explained by a model potential calculation. Measurements of the differential cross section for fine structure transitions in the systems K-Ar, Kr, show directly Stueckelberg oscillations, confirming the asymmetry in the total cross section. ESA

N86-30482# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Kernphysik.
COULOMB DISSOCIATION AS A SOURCE OF INFORMATION ON RADIATIVE CAPTURE PROCESSES OF ASTROPHYSICAL INTEREST
G. Baur, C. A. Bertulani, and H. Rebel Jan. 1986 29 p
(KfK-4032; ISSN-0303-4003; ESA-86-97426) Avail: NTIS HC A03/MF A01

Experimental studies of the break up of light nuclear projectiles in the Coulomb field of a heavy nucleus, acting as a source of

virtual photons, as an access to information about the reverse reaction, the fusion of the fragment particles at small relative energies, are proposed. The mechanism of Coulomb dissociation is studied and the cross section of such reactions, being potentially of astrophysical interest, is estimated. The conditions of dedicated experimental investigations are discussed. ESA

N86-30483# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
THEORETICAL INVESTIGATION OF THE SCATTERING OF THE ROTATION-BENDING COUPLING, AND STUDY OF INTENSITY WEAKENING USING AN OPTICAL MODEL: CALCULATIONS FOR THE SYSTEMS H2-LiF(001) AND HD-Ag(111) Thesis [STREUTHEORETISCHE UNTERSUCHUNG DER ROTATIONS-BEUGUNGS-KOPPLUNG UND STUDIE ZUR INTENSITAET-SABSCHWAECHUNG MIT HILFE EINES OPTISCHEN MODELLS: RECHNUNGEN ZU DEN SYSTEMEN H2-LIF (001) UND HD-AG (111)]
A. Kaufhold Aug. 1985 231 p In GERMAN
(MPIS-16/1985; ISSN-0436-1199; ESA-86-97431) Avail: NTIS HC A11/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 46

The rotation-bending coupling of biatomic molecules during collision on corrugated solid state surfaces was theoretically investigated. The close-coupling calculations were drastically simplified using a cloud potential with simple structure. For relatively strongly corrugated surfaces and highly anisotropic molecules the so-called diffractive rotational selective adsorption resonances were identified. A modified Hantel pair potential model allowed the systematic investigation of processes related to resonances averaged over the change in global molecule mass. For H2-LiF(001) a potential hyperplane was calculated, based on additive, in pairs, two-particle interactions. The scattering intensity weakening was studied by a generalized optical potential model. A method which allows in a relatively simple way to simulate the Debye-Waller factor within close-coupling calculations, and which takes into account effects in the optical potential due to resonance processes was developed. ESA

N86-30484# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
ELEMENTARY REACTIONS OF ELECTRONICALLY EXCITED MOLECULES 6. QUENCHING OF O2(1 DELTA G) BY AMINES, FURANES, PYRROLES, AND THIOPHENES
W. Hack, C. Voehringer, and H. Gg. Wagner Sep. 1985 62 p
(MPIS-21/1985; ISSN-0436-1199; ESA-86-97433) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18

The quenching of singlet oxygen was studied in an isothermal discharge flow system with dimol emission detection. The main carrier gas was He, the total pressure varied in the range 1 to 10 p/mbar. Room temperature quenching rate constants were obtained. The observation that quenching rate constants become pressure dependent at p < or = 3 mbar can be explained by taking into account heterogeneous contributions to the total loss rate. Above p = 3 mbar the reactions are simple homogeneous bimolecular reactions, first order in both O2 and quencher. No simple correlation between physical properties of the quenchers and the rate constants of their quenching reactions is found. The best quencher for O2 in the gas phase is 2,5 dimethylpyrrole. It can be used as a titrant. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N86-30485*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CROSS SECTION CALCULATIONS FOR SUBTHRESHOLD PION PRODUCTION IN PERIPHERAL HEAVY-ION COLLISIONS
John W. Norbury (Old Dominion Univ., Norfolk, Va.), Francis A. Cucinotta, Philip A. Deutchman (Idaho Univ., Moscow.), and Lawrence W. Townsend Aug. 1986 27 p
(Grant NSF PHY-84-11009)
(NASA-TP-2600; L-16129; NAS 1.60:2600) Avail: NTIS HC A03/MF A01 CSCL 20H

Total cross sections angular distributions, and spectral distributions for the exclusive production of charged and neutral subthreshold pions produced in peripheral nucleus-nucleus collisions are calculated by using a particle-hole formalism. The pions result from the formation and decay of an isobar giant resonance state formed in a C-12 nucleus. From considerations of angular momentum conservation and for the sake of providing a unique experimental signature, the other nucleus, chosen for this work to be C-12 also, is assumed to be excited to one of its isovector (1+) giant resonance states. The effects of nucleon recoil by the pion emission are included, and Pauli blocking and pion absorption effects are studied by varying the isobar width. Detailed comparisons with experimental subthreshold pion data for incident energies between 35 and 86 MeV/nucleon are made. Author

N86-30486# Mission Research Corp., San Diego, Calif.
ELECTRON-ION RECOMBINATION IN AIR AT EMP FIELDS Technical Report, 16 Mar. 1984 - 16 Apr. 1985
J. G. Chervenak and V. A. J. vanLint 12 Jun. 1985 68 p
(Contract DNA001-84-C-0137; DNA Proj. X99-QMXV)
(AD-A166211; MRC/SD-R170; DNA-TR-85-202) Avail: NTIS HC A04/MF A01 CSCL 20/4

A pulsed electron beam and a parallel plate ion chamber have been used to measure the electron ion recombination coefficient, beta sub e, in dry and moist air as a function of the electric field. In moist air the value at 1000 V/cm (100,000 V/m) is in agreement with the value normally used in EMP calculations and results from the agglomeration and clustering of the air ions. An increase in beta sub e at lower fields is consistent with a recombination process in which H2O molecules act as a third body. The dry air results are a decade below the moist air values at a given field. Direct measurement of the equilibrium field, E sub s, was made and found to be consistent with the value expected from the measured recombination coefficient. The measured values of beta sub e and E sub s show that three-body recombination is not a significant electron removal process at EMP fields. GRA

N86-30487# Naval Research Lab., Washington, D. C.
THE REBATRON AS A HIGH ENERGY ACCELERATOR
D. Dialetis, S. J. Marsh, and C. A. Kapetanakos 4 Apr. 1986 85 p
(AD-A166624; NRL-MR-5655) Avail: NTIS HC A05/MF A01 CSCL 20/7

A detailed numerical and analytical study of the beam dynamics in a rebatron acceleration has shown that energies approaching 1 GeV can be achieved within 5-10 microseconds. Since the acceleration in the rebatron occurs within a short time, the device may not be sensitive to the various instabilities and the loss to synchrotron radiation should be small. The rapid acceleration is produced by convoluted parallel transmission lines, which provide a high gradient electric field. At the initial stage of the acceleration, the beam is confined inside the torus by a strong focusing torsatron magnetic field, which makes the beam insensitive to the mismatch and to the external field index of a vertical magnetic field. This local field is generated by two coaxial cylindrical plates located symmetrically around the minor axis of the torus, and carrying currents in opposite directions. The energy of the beam increases in synchronism with the vertical magnetic field so that the beam remains matched (i.e., the beam radius remains constant) during the entire acceleration. As a result of the periodic nature of the acceleration, it was found that resonances can be excited, which cause the orbits to expand. The only disruptive resonance occurs at gamma = approx. 1830, i.e., when the vertical magnetic field reaches twice the value of the toroidal magnetic field. GRA

N86-30488# Lawrence Livermore National Lab., Calif.
HIGH AVERAGE POWER INDUCTION ACCELERATORS
J. C. Swingle, ed. Oct. 1985 50 p
(Contract W-7405-eng-48)
(DE86-005288; UCID-20605) Avail: NTIS HC A03MF A01

The induction accelerator is discussed with respect to general background and concept, beam transport, scaling, pulse power technology, and the electron beam injector. A discussion of the factors which affect the scaling of the intensity of the beam is given. Limiting factors include collective forces in the beam, virtual cathode formation, surroundings, and beam breakup instability. DOE

N86-30489# Los Alamos National Lab., N. Mex.
GENERAL-PURPOSE HEAT SOURCE SAFETY VERIFICATION TEST SERIES: SVT-1 THROUGH SVT-6
D. Pavone, T. G. George, and C. E. Frantz Jun. 1985 43 p
(Contract W-7405-eng-36)
(DE85-017956; LA-10353-MS) Avail: NTIS HC A03/MF A01

The General-Purpose Heat Source (GPHS) is a modular heat source that will supply energy for Radioisotope Thermoelectric Generators (RTGs) in space missions. The Safety Verification Tests (SVTs) are performed to assess the plutonium containment capability of heat source modules subjected to certain accident environments. This interim report described the GPHS module configuration, the test environment, and the response of the module components following simulated reentry and solid Earth impact. The specific test environment of these initial six tests results from failure of the booster rocket to place the spacecraft in a proper trajectory and subsequent reentry of the GPHS modules from Earth orbit. DOE

N86-30490# Pacific Northwest Lab., Richland, Wash.
CERMET FUELS FOR SPACE POWER SYSTEMS
J. O. Barner, E. P. Coomes, R. E. Williford, and L. A. Neimark Nov. 1985 5 p Presented at the 3rd Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 13 Jan. 1986 Prepared in cooperation with Argonne National Lab., Ill.
(Contracts W-31-109-eng-38; DE-AC06-76RL-01830)
(DE86-005543; CONF-860102-2) Avail: NTIS HC A02/MF A01

A refractory-metal matrix, UN-fueled cermet is a very promising fuel candidate for a wide range of multi-megawatt space reactor systems, e.g., steady-state, flexible duty-cycle, or bimodal, single- or two-phase liquid-metal cooled reactors, or thermionic reactors. Cermet fuel is especially promising for reactor designs that require operational strategies which incorporate rapid power changes because of its anticipated capability to withstand thermal shock. DOE

N86-30491# Argonne National Lab., Ill.
IN SITU HIGH VOLTAGE ELECTRON MICROSCOPE STUDIES OF ION- AND ELECTRON-BEAM INDUCED MODIFICATION OF MATERIALS
P. R. Okamoto, N. Q. Lam, and A. Taylor Nov. 1985 10 p Presented at the International Symposium on Behavior or Lattice Imperfections in Materials: In Situ Experiments with HVEM, Osaka, Japan, 18 Nov. 1985
(Contract W-31-109-eng-38)
(DE86-005577; CONF-8511159-1) Avail: NTIS HC A02/MF A01

In situ high-voltage electron microscope (HVEM) studies have shown that the highly focused electron beams normally employed for irradiation purposes in the HVEM can cause easily measurable composition changes in the irradiated volume of thin alloy films (Ni-Al). The kinetics of this beam-induced composition change has been investigated and found to exhibit a strong dependence not only on temperature and peak electron flux, but also on the beam diameter. The dependence on beam diameter has far reaching implications for HVEM studies of radiation effects in alloys, and for microchemical analysis techniques. DOE

N86-30492# Los Alamos National Lab., N. Mex.
SPACE NUCLEAR SAFETY PROGRAM Progress Report, Jun. 1984
T. G. George, comp. Nov. 1985 37 p
(Contract W-7405-eng-36)
(DE86-007197; LA-10557-PR) Avail: NTIS HC A03/MF A01

This technical monthly report covers studies related to the use of (238)PuO2 in radioisotope power systems carried out for the Office of Special Nuclear Projects of the US Department of Energy by Los Alamos National Laboratory. Most of the studies discussed are ongoing; the results and conclusions described may change as the work continues. DOE

N86-30493# Los Alamos National Lab., N. Mex.
SPACE NUCLEAR SAFETY PROGRAM Progress Report, Aug. 1984
T. G. George, comp. Nov. 1985 40 p
(Contract W-7405-eng-36)
(DE86-007206; LA-10571-PR) Avail: NTIS HC A03/MF A01

This technical monthly report covers studies related to the use of (238)PuO2 in radioisotope power systems carried out for the Office of Special Nuclear Projects of the US Department of Energy by Los Alamos National Laboratory. Most of the studies discussed are ongoing; the results and conclusions described may change as the work progresses. DOE

74 OPTICS

Includes light phenomena.

N86-30494# Rochester Univ., N. Y. Inst. of Optics.
THE EFFECT OF ABERRATIONS AND APODISATION ON THE PERFORMANCE OF COHERENT IMAGING SYSTEMS Final Report, 3 Nov. 1983 - 30 Sep. 1984
J. P. Mills Feb. 1986 203 p
(Contract F29601-84-K-0014)
(AD-A165886; AFWL-TR-85-80) Avail: NTIS HC A10/MF A01 CSCL 14/5

The effect of aberrations on coherent imaging systems and the utility of apodisation in improving the performance of such systems was theoretically and experimentally investigated. The imaging performance of these systems was evaluated in terms of the images of certain simple objects--a point, two closely-spaced points, an edge, and a slit. Apodisation is defined as the deliberate modification of the amplitude transmittance of the exit pupil of the optical system. The effects on the imaging performance for various amounts of defocus, astigmatism, coma, and spherical aberration were determined for both unapodised and apodised systems. It is well known that for an aberration-free system, apodisation is effective in moderating the deleterious effects of the coherent imaging process. Since all real optical systems have aberrations, this dissertation addressed the more general case of apodisation in aberrated coherent imaging systems. It was found that apodisation was effective in improving the performance of these aberrated systems, i.e., ringing in the image of an edge or slit was greatly reduced and the mensuration error in the image of two points was almost eliminated. The performance of an unaberrated system was seen to be a special case. Experiments have been conducted which verified the theoretical model which was used to make extensive theoretical predictions. GRA

N86-30495# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA OPTICA SINICA (SELECTED ARTICLES)
Min Yi, Chunfei Li, and Qihong Wu 4 Apr. 1986 19 p Transl. into ENGLISH from Guangxue Xuebao (China), v. 5, no. 2, 1985 p 117; 157-161
(AD-A166281; FTD-ID(RS)T-1089-85) Avail: NTIS HC A02/MF A01 CSCL 20/6

An automatic photometric ellipsometer with rotating-analyzer is used in our vacuum thin film coater. This ellipsometer can measure the polarization of the depositing thin film instantly. The inhomogeneity of the refractive index can be analyzed from the path curve of the polarization parameters. Delta and Psi which

vary with the thickness of the thin film. The experimental results show that both Zinc Sulfide and Zinc Selenide have about 100 A of inhomogeneous transition layers at the inner and outer boundaries. In the central region, it has homogeneous refractive index. GRA

N86-30496# Naval Submarine Medical Research Lab., Groton, Conn.

THE EFFECT OF BACKGROUND LUMINANCE AND AMBIENT ILLUMINATION ON COLOR DISCRIMINATION IN A CRT DISPLAY Interim Report

Alan R. Jacobsen 16 Jan. 1986 20 p

(AD-A166297; NSMRL-1070) Avail: NTIS HC A02/MF A01 CSCL 20/6

The ability to discriminate among colors presented on self-luminous displays, such as CRT monitors, continues to be an important area of research. It is widely agreed that when color is used for coding purposes in visual displays, the largest increase in performance will result when the colors used are easily discriminable from one another. A matching task was used to measure the effects of ambient illumination, raster luminance, and target size on color discriminability in a CRT display. A set of ten easily distinguishable colors was presented under two conditions of ambient illumination (dark and bright) and two conditions of raster luminance (low and intermediate). Below this set, a target color was presented as either a circle of 1.4 degrees diameter or a line 1.4 degrees high and 7 minutes wide. Observers were required to match this target with the appropriate color presented in the display above. Under the dark ambient illumination, the intermediate raster yielded faster response times and lower error rates than the low raster. Under the bright ambient, significantly more errors were made with the intermediate than low raster luminance. Color discriminability appears best under conditions where the background luminance is intermediate. Consequently, under dark ambient conditions, raster luminance should be set at an intermediate level but decreased as the ambient light decreases. GRA

N86-30497# Rockwell International Corp., Thousand Oaks, Calif. Science Center.

DIRECTED SYNTHESIS/FABRICATION AND SURFACE MODIFICATION OF IR WINDOW MATERIALS FOR THE 8-14 MICRON REGION Annual Report, 1 Mar. 1985 - 28 Feb. 1986

Alan Harker and Peter Morgan Apr. 1986 11 p

(Contract N00014-85-C-0140)

(AD-A166661; SC5422.AR; AR-1) Avail: NTIS HC A02/MF A01 CSCL 20/6

Nearly monosize particles of pure NaLaS2 have been made by a sulfide fused salt technique. Such particles promise easier compaction and HIPing to highly dense IR window material. The increased fracture toughness of glass substrates due to the addition of a thin compressive overlayer has been measured. The fracture toughness appears to increase linearly with the total film stress and is independent of the film thickness necessary to provide that stress. GRA

N86-30498# Universal Energy Systems, Inc., Dayton, Ohio.

CRITERIA FOR SELECTION OF GRADED INDEX FILTER MATERIALS BASED ON AN ANALYSIS OF WAVE PROPAGATION IN A PERIODIC MEDIUM Final Report, 10 Aug. 1984 - 28 Feb. 1985

Roger J. Becker Jan. 1986 142 p

(Contract F33615-82-C-5001)

(AD-A166809; AFWAL-TR-85-4129) Avail: NTIS HC A07/MF A01 CSCL 20/6

This report includes a survey of the factors affecting the performance of a filter. Although specifically directed at optical filters, most of the discussion is quite general, applying to the propagation of any wave in a medium with a spatially modulated response or susceptance. The intent of this work is to examine the factors affecting filter performance with a view toward perfecting filter design, to gain a deeper understanding of the relationship between rugate index profile parameters and the consequent optical properties, and to guide rugate deposition experiments. A wide range of systems which are usually treated as unique share important features with optical filters. Examples are acoustic filters, electronic energy bands in solid, lattice dynamics, transmission line theory, and waveguide theory. This report begins to lay the groundwork for development of an optimum transfer function and to determine the appropriate values for the filter parameters. GRA

N86-30499# Department of the Air Force, Washington, D.C.

FIBER OPTIC ROTARY SWITCHING DEVICE Patent Application

Stanley D. Battle, inventor (to Air Force) Filed 15 Jan. 1986 14 p

(AD-D012231; US-Patent-Appl-SN-818922) Avail: NTIS HC A02/MF A01 CSCL 20/6

A fiber optic rotary switching device having a single optical fiber rotatable between a plurality of optical fibers is described. The arrangement for rotating the single optical fiber is designed such that the single optical fiber flexes but does not twist with respect to an end thereof which is fixed to a light source (or, in the alternative to a light detector). As a result, the switching device switches light passing through the single optical fiber to a preselected one of the plurality of optical fibers while simultaneously preventing extraneous light from reaching the other optical fibers. GRA

N86-30500# Oak Ridge National Lab., Tenn.

SCATTERING AND ABSORPTION OF LIGHT DUE TO SURFACE RESONANCES ON SUBMICRON OBLATE SPHEROIDAL PARTICULATES

S. W. Kennerly, R. J. Warmack, and T. L. Ferrell Jan. 1986 90 p

(Contract DE-AC05-84OR-21400)

(DE86-005261; ORNL/TM-9407) Avail: NTIS HC A05/MF A01

The experimental part of this report consists of measuring the optical absorbance of a collection of silver oblate spheroidal particulates as a function of wavelength, polarization, and angle of incidence. The method of producing such a collection is described along with measuring a few of the important characteristics like particle size, separation, and density. The experimental data are then compared with theoretical absorbances calculated using scattering and absorption cross sections. The cross sections are derived using a dipole approximation. DOE

N86-30501# KMS Fusion, Inc., Ann Arbor, Mich.

STIMULATED RAMAN SCATTERING: COMPARISON OF THEORY AND EXPERIMENT

R. L. Berger, G. E. Busch, E. F. Gabl, R. J. Schroeder, C. L. Shepard, and J. A. Tarvin 1985 12 p Presented at the 7th International Workshop on Laser Interaction and Related Plasma Phenomena, Monterey, Calif. 28 Oct. 1985

(Contract DE-AC08-82DP-40152)

(DE86-006480; KMSF-U-1671; CONF-851053-10) Avail: NTIS HC A02/MF A01

Experiments at KMSF and elsewhere have observed stimulated Raman scattered light whose energy is correlated with the energy in hot electrons as expected, on the basis of energy conservation in the three wave process (Manley Rowe relations). The instability is observed under conditions that are below the theoretical threshold for the convectively unstable interaction, and above that for the absolutly unstable interaction. However, the spectral characteristics are those of the convective modes. The laser intensity threshold is measured to be independent of the plasma density scale length, rather than inversely dependent on the scale length as theoretically predicted if the threshold is defined by the observation of SRS light. However, the amount of SRS light increases exponentially with laser intensity as expected for a convective instability. The SRS light is typically concentrated in rather short wavelengths where the associated Langmuir wave should be strongly damped. These spectral characteristics are not explained by the wavelength variation of the gain or the bremsstrahlung light wave source. Calculations were given to show that

the Langmuir wave source has the right properties to reproduce the observed spectra. DOE

N86-30502# Lawrence Livermore National Lab., Calif.
VERSATILE LASER GLASS INSPECTION AND DAMAGE TESTING FACILITY
J. E. Marion, G. J. Greiner, J. H. Campbell, P. H. Chaffee, J. S. Hildum, J. Z. Grens, C. L. Weinzapfel, S. M. Winfree, and D. Milam 17 Jan. 1986 11 p Presented at the Boulder Damage Symposium, Boulder, Colo. 5 Oct. 1985
(Contract W-7405-eng-48)
(DE86-006306; UCRL-93251; CONF-8510101-4) Avail: NTIS HC A02/MF A01

A test facility is described which detects small opaque inclusions in large transparent components by using a commercial laser which delivers high energy pulses to the test sample at moderate frequency in a small diameter beam. The sample is automatically scanned such that each point in the volume is irradiated with ten pulses at twice the inclusion damage threshold - an amount sufficient to cause visible damage at inclusion sites. This approach permits detection of opaque inclusions in the parts per trillion and lower concentration range. The specifics of the device design and its performance are discussed in the context of automatic inclusion inspection and mapping in large laser optics. DOE

N86-30503# Lawrence Livermore National Lab., Calif.
VARIED LINE-SPACE GRATINGS: PAST, PRESENT AND FUTURE
M. C. Hettrick Aug. 1985 16 p Presented at the SPIE International Technical Symposium on Optical and Electro-Optical Engineers, San Diego, Calif., 18 Aug. 1985
(Contract DE-AC03-76SF-00098)
(DE86-007498; LBL-20115; CONF-850887-44) Avail: NTIS HC A02/MF A01

A classically ruled diffraction grating consists of grooves which are equidistant, straight and parallel. Conversely, the so-called holographic grating (formed by the interfering waves of coherent visible light), although severely constrained by the recording wavelength and recording geometry, has grooves which are typically neither equidistant, straight nor parallel. In contrast, a varied line-space (VLS) grating, in common nomenclature, is a design in which the groove positions are relatively unconstrained yet possess sufficient symmetry to permit mechanical ruling. Such seemingly exotic gratings are no longer only a theoretical curiosity, but have been ruled and used in a wide variety of applications. These include: (1) aberration-corrected normal incidence concave gratings for Seya-Namioka monochromators and optical demultiplexers, (2) flat-field grazing incidence concave gratings for plasma diagnostics, (3) aberration-corrected grazing incidence plane gratings for space-borne spectrometers, (4) focusing grazing incidence plane grating for synchrotron radiation monochromators, and (5) wavefront generators for visible interferometry of optical surfaces (particularly aspheres). Future prospects of VLS gratings as dispersing elements, wavefront correctors and beam-splitters appear promising. The author discusses the history of VLS gratings, their present applications, and their potential in the future. DOE

N86-30504# Krupp Atlas-Elektronik, Bremen (West Germany).
NEW ACOUSTO-OPTICAL BEAM FORMER Final Report, Dec. 1983
Dirk Rathjen Bonn Bundesministerium fuer Forschung und Technologie Dec. 1985 67 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-85-154; ISSN-0340-7608; ESA-86-97440) Avail: NTIS HC A04/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 14

A laboratory model of an optically incoherent processor which can be used for beam forming on linear antenna arrays is described. The individual electronic sensor signals are converted into light. The beam forming is achieved by spatial filtering of the overall light distribution in an acousto-optical modulator. For narrow-band signals, the array beam pattern is controlled by varying the spatial frequency of the sinusoidal filter function. The theoretical fundamentals of the processor, and measurement results with synthetic and real underwater sound signals are presented. The signals of an eight-sensor array can be processed. A dynamic range of 35 dB is achieved without particularly high technical complexity. Although the laboratory model is a large, heavy structure which is not suitable for practical use, the concept, when applied to other technologies, opens up possibilities for the development of small, light-weight modules for large arrays. ESA

N86-30505# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
FIBER OPTICAL DATA LINK EXTENSION FOR THE IEC-625 INTERFACE BUS
Gerd-Jan Dijkers Dec. 1984 81 p
(ESA-86-97532) Avail: NTIS HC A05/MF A01

A fiber optics device capable of extending the limited length of 20 m of a normal IEC-bus to 5 km was designed. Maximum throughput rate of 1 Mbyte/sec is feasible, with slower throughput rates in the command mode, which is acceptable when the number of bytes in the command mode is much smaller. Software changes in the controller are necessary when it is desirable to empty the FIFO-memory of the device. When these software changes are not made, it is possible that data bytes, stored in the FIFO-memory during the data mode, can not get out of this memory and are lost. No parallel poll possibilities exist for the extended devices. ESA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N86-30506# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering and Appl. Physics.
ONE-COMPONENT PLASMA MODEL AND LARGE Z LABORATORY PLASMAS Interim Report, Aug. - Dec. 1985
Richard L. Liboff and G. L. Ferrentino (Army Armament Research and Development Command, Dover, N. J.) Apr. 1986 16 p Sponsored in part by Battelle Columbus Labs., Ohio
(Contract DAAG29-81-D-0100)
(AD-A166606; ARFSD-CR-86005) Avail: NTIS HC A02/MF A01 CSCL 20/9

Stemming from an expression for the mean two-particle potential energy of a two-component laboratory plasma comprised of ions of charge Ze and electrons, it is argued that for sufficiently large Z, thermodynamic properties of such plasmas are the same as those relevant to Wigner's one-component plasma model, Thus, an equation of state is obtained for a strongly coupled laboratory plasma with Z greater than or approximately 5. GRA

N86-30507# California Univ., Berkeley. Lawrence Berkeley Lab.
DESIGN AND FABRICATION OF AN ACTIVELY COOLED LANGMUIR PROBE FOR LONG PULSE APPLICATIONS
J. A. Paterson, L. A. Biagi, K. W. Ehlers, and G. W. Koehler Nov. 1985 4 p Presented at the 11th Symposium on Engineering Problems in Fusion Research, Austin, Tex., 18 Nov., 1985
(Contract DE-AC03-76SF-00098)
(DE86-005231; LBL-19531; CONF-851102-77) Avail: NTIS HC A02/MF A01

The details of the mechanical design and fabrication for a Langmuir Probe for the continuous monitoring of plasma density are given. The probe was designed for use as a diagnostic tool in the development of long pulse positive ion plasma sources for use on neutral beam systems. The essential design feature of this probe is the incorporation of two electrically isolated cooling water circuits which actively cool the probe tip and probe jacket.

The electrical isolation is required to prevent drain currents from the probe body disturbing the measurement of the probe tip current and thereby the plasma density measurement. The successful realization of the design requires precision components and vacuum tight ceramic to refractory metal brazes. To date this design has successfully operated in steady-state in plasma densities up to 250 mA/cm² and surface heat fluxes of 25 W/cm². DOE

N86-30508# Princeton Univ., N. J. Plasma Physics Lab.
MEASUREMENT OF POPULATION INVERSIONS AND GAIN IN CARBON FIBER PLASMAS
H. Milchberg, C. H. Skinner, S. Suckewer, and D. Voorhees Oct. 1985 16 p
(Contract DE-AC02-76CH-03073)
(DE86-002532; PPPL-2274) Avail: NTIS HC A02/MF A01

A CO2 laser (approx. 0.5 kJ energy, 70 nsec pulse width) was focussed onto the end of an axially oriented, thick (35-350 microns)carbon fiber with or without a magnetic field present along the laser-fiber axis. Evidence is presented for axial-to-transverse enhancement of the CVI 182A (n = 3 + 2) transition, which is correlated with the appearance of a population inversion between levels n = 3 and 2. For the B = O kG, zero field case, the maximum gain-length product of kl approx. equal to 3 (k approx. equal to 6/cm) was measured for a carbon fiber coated with a thin layer of aluminum (for additional radiation cooling). The results are interpreted in terms of fast recombination due mostly to thermal conduction from the plasma to the cold fiber core. Author

N86-30509# Princeton Univ., N. J. Plasma Physics Lab.
GENERALIZED BANANA-DRIFT TRANSPORT
H. E. Mynick Oct. 1985 50 p
(Contract DE-AC02-76CH-03073)
(DE86-002535; PPPL-2271) Avail: NTIS HC A03/MF A01

The theory of tokamak ripple transport in the banana-drift and ripple-plateau is extended in a number of directions. The theory is valid for small values of the toroidal periodicity number n of the perturbation, as well as for the moderate values (n approx. 10 - 20) previously assumed. It is shown that low-n perturbations can produce much greater transport than the larger-n perturbations usually studied. In addition, the ripple perturbation is allowed arbitrary values of poloidal mode number m and frequency omega, making it applicable to the transport induced by MHD modes. Bounce averaging is avoided, so the theory includes the contributions to transport from all harmonics of the bounce frequency, providing a continuous description of the transition from the banana drift to the ripple-plateau regime. The implications of the theory for toroidal rotation in tokamaks are considered. Author

N86-30510# Princeton Univ., N. J. Plasma Physics Lab.
RESISTIVE INSTABILITIES IN TOKAMAKS
P. H. Rutherford Oct. 1985 35 p
(Contract DE-AC02-76CH-03073)
(DE86-002538; PPPL-2277) Avail: NTIS HC A03/MF A01

Low-m tearing modes constitute the dominant instability problem in present-day tokamaks. The stability criteria for representative current profiles with q(0)-values slightly less than unity are reviewed; 'sawtooth' reconnection to q(0)-values just at, or slightly exceeding, unity is generally destabilizing to the m = 2, n = 1 and m = 3, n = 2 modes, and severely limits the range of stable profile shapes. Feedback stabilization of m less than or equal to 2 modes by rf heating or current drive, applied locally at the magnetic islands, appears feasible; feedback by island current drive is much more efficient, in terms of the radio-frequency power required, than feedback by island heating. Feedback stabilization of the m = 1 mode -- although yielding particularly beneficial effects for resistive-tearing and high-beta stability by allowing q(0)-values substantially below unity -- is more problematical, unless the m = 1 ideal-MHD mode can be made positively stable by strong triangular shaping of the central flux surfaces. Feedback techniques require a detectable, rotating MHD-like signal; the slowing of mode rotation -- or the excitation of non-rotating modes -- by an imperfectly conducting wall is also discussed. Author

N86-30511# California Univ., Los Angeles. Dept. of Fusion Engineering.
TECHNICAL ISSUES AND REQUIREMENTS OF EXPERIMENTS AND FACILITIES FOR FUSION NUCLEAR TECHNOLOGY, FINESSE PHASE 1, VOLUME 2
Dec. 1985 654 p
(Contract DE-AS03-84ER-52105)
(DE86-006503; PPG-909-Vol-2; UCLA-ENG-85-39-Vol-2) Avail: NTIS HC A99/MF A01

Liquid metal blankets are discussed with respect to the critical issues, existing facilities, basic measurements, modeling techniques, material interactions, insulators, electromagnets, and tritium recovery. These topics are also discussed with regard to solid breeder blankets. In addition, tritium processing, vacuum systems, and plasma interactive components are discussed. Existing fusion facilities are described, and blanket development planning is discussed. DOE

N86-30512# Texas Univ., Austin. Institute for Fusion Studies.
TWO DIMENSIONAL ANALYTICAL CONSIDERATIONS OF LARGE MAGNETIC AND ELECTRIC FIELDS IN LASER PRODUCED PLASMAS
S. Eliezer and A. Loeb (Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.) Aug. 1985 25 p
(DE86-00235; DOE/ET-53088/200) Avail: NTIS HC A02/MF A01

A simple model in two dimensions is developed and solved analytically taking into account the electric and magnetic fields in laser produced plasmas. The electric potential in this model is described by the nonlinear differential equation d-squared psi/dx-squared + psi(d psi/dx)/(1 - psi) = 0, psi = (e phi)/T, where (e phi) is the electric potential energy and T is the temperature in energy units. The physical branch psi < 1, defined by the electron density n = n(0) exp psi boundary conditions n(x = 0) = const and n(x = (+)infinity) = 0, introduces a typical electrostatic double layer. The stationary solution of this model is consistent for -0.1 approx. < psi < 1, with electron temperature in the KeV region and a ratio of the electric (E) to magnetic (B) fields of [E/10(6) v/cm]/[B/MGauss] being approximately 1. M.G.

N86-30513# Paris-Sud Univ., Orsay (France). Lab. de Physique des Gaz et des Plasmas.
RADIAL DISTRIBUTION OF EXCITED ATOMS IN A PLASMA COLUMN PRODUCED BY A SURFACE WAVE [DISTRIBUTION RADIALE DES ATOMES EXCITES DANS UNE COLONNE DE PLASMA PRODUITE PAR UNE ONDE DE SURFACE]
C. M. Barbeau, H. Hubert, M. Moisan, and A. Ricard Jan. 1986 52 p In FRENCH
(LP-214; ESA-86-97187) Avail: NTIS HC A04/MF A01

The radial distribution of excited states of He, Ne and Ar were studied either individually or in mixtures with one another and with O2. The plasma columns are produced by a high frequency wave (300 to 1000 MHz) propagating along the tube surface and penetrating radially. The flat profiles obtained are related to the propagation of the radial electric field which follows a modified Bessel function, where its parameter is a function of the electron density. The spectrum lines of metastable states present positive curvature profiles, while those of the fundamental states are more often of negative curvature. In the condition of high power absorption obtained by multiple reflexions the concentration of metastable states is very high and the radial distribution profile is flat. ESA

N86-30514# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorwerkstoffe.
STUDY OF SURFACES AND SURFACE LAYERS ON HIGH TEMPERATURE MATERIALS AFTER SHORT-TIME THERMAL LOADS
H. Bolt, H. Hoven, K. Koizlik, J. Linke, H. Nickel, and E. Wallura Nov. 1985 77 p
(JUEL-2024; ISSN-0366-0885; ESA-86-97422) Avail: NTIS HC A05/MF A01

Erosion and redeposition processes of first wall materials during

tokamak operation are discussed. An important redepareition process of eroded material is the formation of thin films by atomic condensation. Examinations of first wall components after operation suggest that these thin metallic films tend to agglomerate to small particles under subsequent heat load. Laboratory experiments show that thin metallic films on various substrates can agglomerate under short time high heat fluxes and also under longer lasting lower thermal loads, thus verifying the agglomeration hypothesis. ESA

N86-30515# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Plasmaphysik.
ENHANCED SMALL SCALE TURBULENCE OSCILLATIONS CORRELATED TO SAWTOOTH RELAXATIONS IN THE TEXTOR TOKAMAK
A. Rogister, G. Hasselberg, A. Kaleck, A. Boileau, H. W. H. VanAndel, and M. vonHellermann Nov. 1985 34 p
(JUEL-2025; ISSN-0366-0885; ESA-86-97423) Avail: NTIS HC A03/MF A01

A periodic enhancement of the microturbulence level by sawtooth relaxations was detected by CO2 laser forward scattering in the TEXTOR tokamak. This feature is reproduced quantitatively by a heat transport code in which the anomalous electron transport coefficient is calculated self consistently following a theoretical model of the saturation of the dissipative trapped electron instability. The code also predicts a strong modulation of the heat flux throughout the whole plasma and a strong profile consistency as continuous temperature measurements demonstrate. Calculated global plasma parameters, such as the energy confinement time and the loop voltage, are in good agreement with the measured values. ESA

N86-30516# Technische Hogeschool, Eindhoven (Netherlands). Onderwerpgroep Atoom- en Plasmafysica.
AN INVESTIGATION OF DISCHARGE STRUCTURES IN THE SUBMILLIMETER BAND IN AN MHD GENERATOR [EEN ONDERZOEK NAAR ONTLADINGSSTRUCTUREN IN HET SUBMILLIMETERGEBIED IN EEN MHD GENERATOR]
H. J. W. Schenkelaars Aug. 1984 96 p In DUTCH
(VDF-NT-84-16; ESA-86-97549) Avail: NTIS HC A05/MF A01

The characteristic length scale of the discharge structure occurring in an MHD generator was determined using collective scatterings of CO2 laser light and heterodyne detection techniques. Mixing of scattered and nonscattered radiation was used to get a spatial resolution in the submillimeter range and to increase the signal to noise ratio. A discharge model to interpret the measured signals was formulated. The length scale of the electron density fluctuations of (2.5 + or - 0.5) x 0.0001 m is found. The smallest diameter of the substructure is explained by elaborating particle and energy balance equations. A characteristic discharge diameter of (2 to 4) x 0.0001 m for electron temperatures between 2500 and 4000 K and a 3000 V/m electric field is found by balancing Joule dissipation and electron heat conductivity terms. For temperatures falling outside the temperature field, terms lost become of increasing importance, probably due to radiation processes and dissociative recombination. ESA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N86-30517*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
A SUPERCONDUCTING TUNNEL JUNCTION RECEIVER FOR MILLIMETER-WAVE ASTRONOMY
Shing-Kuo Pan and Anthony R. Kerr Jul. 1986 243 p
(NASA-TM-87792; NAS 1.15:87792) Avail: NTIS HC A11/MF A01 CSCL 20L

The development and construction of an ultralow noise heterodyne receiver for millimeter wave astronomy is described along with its use for 115.3 GHz Co line observations. The receiver uses a Superconductor-Insulator-Superconductor (SIS) quasiparticle tunnel junction mixer to convert the millimeter wave signal to a microwave intermediate frequency. Experiments aimed at quantitative verification of J. R. Tucker's quantum mixer theory are studied, to see whether it could be used as the basis for the design of a practical receiver. The experimental results were in excellent agreement with the theory, assuming the three frequency approximation. Infinite available gain and negative output resistance were observed for the first time, nonclassical effects which are not seen in conventional diode mixers. Using Tucker's theory, an SIS receiver was then designed and constructed. At 115 GHz, the single sideband receiver noise temperature is 83K, the lowest ever reported in this frequency range. A CO survey toward Cygnus-X region, using this SIS receiver on the Columbia-GISS 4 ft. telescope, is also described. Author

N86-30518*# National Aeronautics and Space Administration, Washington, D.C.
PREPARATION AND OPTICAL PROPERTIES OF GA(X)IN(1-X)P ALLOYS
H. Rodot, J. Horak, G. Rouy, and J. Bourneix May 1986 9 p Transl. into ENGLISH from Comptes Rendus, Serie B, Sciences Physiques (Paris, France), v. 269, no. 9, 1 Sep. 1969 p 381-384 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88431; NAS 1.15:88431) Avail: NTIS HC A02/MF A01 CSCL 20L

The solution crystallization method was used to obtain Ga(z)In (1-x)P alloys for all values of x desired between zero and 1. The method of preparation makes it possible to crystallize the solid at a constant temperature. The points obtained by cathodoluminescence are nearly in straight lines. The optical absorption thresholds are confirmed in the results and make it possible to define the nature of the transitions except when x is in the neighborhood of 0.65. These determinations agree with those of Hilsum and Porteus (1968), but are not in agreement with those obtained by Lorenz et al, (1968). Author

N86-30519# Colorado Research Development Corp., Fort Collins.
SEMICONDUCTING TRANSITION METAL SILICIDES FOR ELECTRO-OPTIC VSLI INTERCONNECTS Interim Report
John E. Mahan 15 Jan. 1986 6 p
(Contract N00014-85-C-0874)
(AD-A165895; IR-3) Avail: NTIS HC A02/MF A01 CSCL 20/12

We have optically characterized the CrSi2 samples, and fabricated thin films of MnSi(1.7) and IrSi(1.75). X-ray analysis of the latter two silicides has also been accomplished. These developments are summarized. A forbidden energy gap of approx. 0.3eV is obtained from the onset of strong absorption at that energy. The interference fringes correspond to a refractive index-film thickness product of approx. 10 microns; the estimated film thickness of 2.4 microns gives a refractive index of approximately 4.2 below the absorption edge. Thin films of this material were formed by ion beam sputtering and furnace reaction techniques as described for CrSi2 in our first progress report. X-ray diffraction analysis of the films confirms the presence of the semiconducting manganese silicide, with no other detectable phase except the silicon substrate. A representative X-ray diffraction pattern for a film formed at 750C is shown. Again, the data indicate the well-crystallized semiconducting silicide phase and no other except for the silicon substrate. GRA

N86-30520# Columbia Univ., New York.
INSTRUMENTATION FOR SURFACE STUDIES FOR NOVEL ELECTRONICS PROCESSING Final Report, 15 Dec. 1984 - 14 Dec. 1985
R. M. Osgood Dec. 1985 11 p
(Grant AF-AFOSR-0046-85)
(AD-A166093; AFOSR-86-0051TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

The instrumentation purchased on this contract is to be used in the study of solid-surface phenomena and the relation of these

phenomena to developing new processing or fabrication techniques for micro-electronics. Development of new processing techniques including laser direct writing, photon-assisted dry processing, the formation of metal silicides, and ion etching are currently major research efforts in the Columbia Microelectronics Sciences Laboratories. The work is supported by research contracts with AFOSR, DARPA, JSEP, and Rome Air Development Center. GRA

N86-30521# United Technologies Research Center, East Hartford, Conn.

THEORETICAL STUDY OF THE RADIATIVE AND KINETIC PROPERTIES OF SELECTED METAL OXIDES AND AIR MOLECULES Final Technical Report, 15 Jan. 1983 - 5 Feb. 1985

H. H. Michels and R. H. Hobbs 1 May 1985 89 p

(Contract DNA001-83-C-0044; DNA Proj. S99-QMXB)

(AD-A166113; UTRC-926388; DNA-TR-85-156) Avail: NTIS HC A05/MF A01 CSCL 07/4

A theoretical research program directed toward the study of the energetics and LWIR radiative properties of selected uranium/oxygen band systems has been undertaken. Included in this research program was the investigation of the strongest electronic and vibrational bands in the LWIR region for the species UO, UO(+), UO2, UO(++). The program for accomplishing this research effort was formulated into three separate tasks: a) adaption of our electronic structure codes to the DNA CYBER 176 System, b) calculation of pertinent electronic wavefunctions and energies, as a function of internuclear separation within a relativistic framework, for selected species of the uranium/oxygen system which may be important in the LWIR region, and c) calculation of electronic transition moments and transition probabilities between specific vibrational levels of the electronic states corresponding to the strongest radiating band systems belonging to the uranium/oxygen system and prediction of IR and possible optical oscillator strengths. Our calculations indicated that the species UO(+) will be efficiently solar pumped and will exhibit strong absorption/radiation. Further, we predict efficient conversion of solar photons to IR photons for this species. GRA

N86-30522# Westinghouse Research and Development Center, Pittsburgh, Pa.

SUPERCONDUCTING ELECTRONIC FILM STRUCTURES Semi-annual Report, 1 Jan. - 30 Jun. 1985

A. I. Braginski and J. R. Gavaler 5 Aug. 1985 20 p

(Contract F49620-85-C-0043)

(AD-A166183; Rept-85-9C9-SUPER-R2; AFOSR-86-0097TR) Avail: NTIS HC A02/MF A01 CSCL 20/12

Data from Nb/Sn and Nb/Al diffusion couple experiments provided supporting evidence for a proposed hypothesis that superconducting A15 compounds are formed via an oxygen catalyzed reaction. Both epitaxy, and the addition of an impurity (carbon) were successful in increasing the critical temperatures of NbN deposited at low temperature. Critical temperatures of over 16K were obtained in epitaxially grown NbN films sputtered on substrates held at less than 100 C. RHEED (reflection high energy electron diffraction) and X-ray rocking curve data show that the new UHV deposition and analytical facility has the capability for epitaxially growing high quality single crystals of the technologically important A15 and B1 superconductors. Low-leakage all-NbN tunnel junctions have been developed with ion-beam oxidized Al and Mg barriers, or rf-sputtered MgO barriers. The first Nb-Sn based junctions with refractory counterelectrodes were fabricated. XPS, RHEED, and tunneling have been used to characterize: (1)the structure of epitaxial films, (2)the role of ion-beam oxidation in the preparation of tunnel barriers that can be used with refractory counter electrodes, and (3)anisotropic surface oxide growth on single crystal films. Nb single crystal films were prepared which have three times lower rf surface losses compared to polycrystalline Nb. Author (GRA)

N86-30523# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPARATIVE STUDIES OF ELECTRON AFFINITIES AND WORK FUNCTIONS FOR GaAs AMD Si

Yirong Xing 14 Mar. 1986 20 p Transl. into ENGLISH from Bandaoti Xuebao (China), v. 6, no. 4, Jul. 1985 p 362-368

(AD-A166225; FTD-ID(RS)T-1181-85) Avail: NTIS HC A02/MF A01 CSCL 07/4

Ultra-violet Photoemission Spectra (UPS) involving core level photoemission peaks (Ga 3d for GaAs and Si 2p for Si) is measured for the (111), (110), (111), and (001) surfaces of GaAs and Si using the light from a Helium lamp (21.2 eV and 40.8 eV) and from the Berlin synchrotron radiation source BESSY (108.6 eV), respectively. These surfaces are prepared by ion bombardment and annealing on cylindrically shaped GaAS and Si crystals with 110 as their axis. The GaAs cylinder is in addition prepared by molecular beam epitaxy yielding As-rich phases on (111) and (001). The work function Phi and the electron affinity x are evaluated from the low energy (secondary electron) threshold and the energy position of the core level photoemission peak. It is shown that due to the crystal polarity and differences in surface composition, the electron affinity depends strongly on the orientation for GaAs. For Si, the missing bulk polarity is responsible for the small variations of X, which may be caused by the different surface reconstructions. On GaAs, the Variation of Phi and X are essentially parallel indicating no strong band bending variations. On Si, however, the relatively strong variations of Phi indicate strong variations of the band bending. GRA

N86-30524# Cornell Univ., Ithaca, N.Y.

EXPERIMENTAL STUDY OF ELECTRONIC STATES AT METAL-DIELECTRIC INTERFACES Interim Technical Report, 2 Feb. 1981 - 1 Feb. 198

A. J. Sievers 23 Dec. 1985 21 p

(Grant AF-AFOSR-0121-81)

(AD-A166242; AFOSR-86-0077TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

By means of new infrared techniques we are exploring both the time and frequency domain spectra of electronic interface states. These data can be used to obtain information specific to interfaces such as mobility and diffusion, lifetimes, energy levels and the density of states. We shall continue the development of new infrared techniques which are ideally matched to the interface problem and then use these techniques to measure and characterize the physical properties of electronic states at metal-dielectric interfaces. Since these techniques rely on evanescent electromagnetic waves a closely related objective is to explore the near field electrodynamics of structures which produce evanescent fields. Metal semiconductor interfaces can be studied with broadband SEW spectroscopy using incoherent thermal radiation for a source and the surface photoconductivity for a detector. With coherent sources power dependent absorption measurements and also light scattering from surface electrokinetic phenomena become feasible. These instruments will not only be used to probe the excitation spectra of metal-semiconductor interface states but also to explore the magnetic field dependence of the energy levels in n-type InSbNiSb eutectic. GRA

N86-30525# Minnesota Univ., Minneapolis. School of Physics and Astronomy.

SUPERCONDUCTIVITY OF THIN FILM INTERMETALLIC COMPOUNDS Annual Report, 1 Sep. 1984 - 31 Aug. 1985

Allen M. Goldman 15 Sep. 1985 53 p

(Grant AF-AFOSR-0347-84)

(AD-A166271; AFOSR-86-0155TR) Avail: NTIS HC A04/MF A01 CSCL 20/3

The macroscopic as well as microscopic properties of selected thin film superconducting compounds are being investigated. The materials being studied are either members of technologically significant systems or involve possible unique mechanisms for superconductivity whose realization should extend the range of critical parameters to either higher temperatures of higher critical fields. Materials under study are the superconducting Cheverel phase compounds, selected Heavy Fermion compounds and a low carrier density superconductor, T1 doped PbTe. The latter is being investigated with an idea to understanding the superconduc-

ting field effect. Processing of the Chevrel Phase compounds is carried out in a multi-source deposition system. The latter has been upgraded and improved during the grant period. The electrical and magnetic properties of the reentrant superconductor HoMo6S8 have been investigated in some detail with the magnetic and superconducting character of the low-temperature phase found to be dependent on the degree of disorder in the film. Single crystal films of the Heavy Fermion compound UPt3 have been prepared. Although these films are highly ordered they have not been found to be superconducting, perhaps because they are off stoichiometry by as little as one percent. GRA

N86-30526# California Univ., Santa Barbara. Quantum Inst.
ON THE INTERPLAY BETWEEN CHEMICAL REACTIONS AND PHASE TRANSITIONS FOR MOLECULES ADSORBED ON SOLID SURFACES Annual Report
Mark Stiles and Horia Metiu Feb. 1986 28 p
(Contract N00014-81-K-0598)
(AD-A166273; TR-15) Avail: NTIS HC A03/MF A01 CSCL 07/4

There is a large body of experimental evidence suggesting that the rate of product formation in a reaction between adsorbed molecules is deeply modified when one of the reagents undergoes a phase transition or, more broadly speaking, an aggregation of some kind. Specific examples are: H2 and CO oxidation; methanol transformation into a methoxy radical on O/Cu; the water reaction with oxygen to form 2OH; the decomposition of N2O on Pt(111) which is affected by a phase transition in the outermost Pt layer; and the oxidation of Ni7. It is suspected that similar effects might operate on supported metal catalysts. We use Monte Carlo simulations to examine the manner in which reagent aggregation affects the reaction rate between molecules adsorbed on a solid surface. We discuss the temperature and concentration dependence of the rate of product formation. GRA

N86-30527# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.
EXPERIMENTAL STUDY OF ELECTRONIC STATES AT METAL-DIELECTRIC INTERFACES Final Report, 2 Feb. 1981 - 31 May 1985
A. J. Sievers 23 Dec. 1985 51 p
(Grant AF-AFOSR-0121-81)
(AD-A166274; AFOSR-86-0080TR) Avail: NTIS HC A04/MF A01 CSCL 07/4

Novel high resolutions electromagnetic wave techniques have been used in the optical, infrared and far infrared spectral regions to explore the electronic states at metal dielectric interfaces. Because infrared surface plasmons on metal surfaces propagate for many wavelengths, a measurement of the transmission of these surface excitations has proven to be a sensitive probe of the surface itself. Both broadband and single frequency generation techniques have been developed. Reconstructed surfaces as well as surfaces covered with a chemisorbed atomic monolayer or a thin dielectric or molecular film have been investigated with these new methods. GRA

N86-30528# Cornell Univ., Ithaca, N.Y.
EXPERIMENTAL STUDY OF ELECTRONIC STATES AT METAL-DIELECTRIC INTERFACES Interim Technical Report, 2 Feb. 1982 - 1 Feb. 198
A. J. Sievers 23 Dec. 1985 9 p
(Grant AF-AFOSR-0121-81)
(AD-A166290; AFOSR-86-0076TR) Avail: NTIS HC A02/MF A01 CSCL 07/4

Because infrared surface plasmons on metal surfaces propagate for many wavelengths, a measurement of the transport of these excitations can be used to monitor the surface itself, using the metal edge with a broadband continuous source. Measurements of the transmission of IR surface plasmons across metal surfaces covered with a chemisorbed atomic monolayer or with thin dielectric or molecular films have been carried out and, compared with those obtained by reflection spectroscopy. GRA

N86-30529# California Univ., Santa Barbara. Quantum Inst.
A MULTIPLE GAUSSIAN WAVE PACKET THEORY OF H2 DIFFRACTION AND ROTATIONAL EXCITATION BY COLLISION WITH SOLID SURFACES Annual Report
Bret Jackson and Horia Metiu Feb. 1986 43 p
(Contract N00014-81-K-0598)
(AD-A166291; TR-11) Avail: NTIS HC A03/MF A01 CSCL 07/4

The Gaussian wave packets and the coupled channel method are combined to develop a theory of H2 diffraction and rotational excitation by collision with surfaces. This improves our previous work on H2 diffraction since it eliminates the mean trajectory approximation; it also extends Heller's work to problems in which the dynamics require the creation of new packets which must be coupled to each other as they are propagated through the interaction region. The approximations involved in the above Gaussian wave packet approach can be removed by extending a method proposed by Flect, Morris and Felt, which propagates the Gaussian wave function exactly and efficiently. GRA

N86-30530# Chicago Univ., Ill. Dept. of Chemistry.
PSEUDOPOTENTIALS AND STRUCTURE-PROPERTY RELATIONSHIPS IN THE SOLID STATE Annual Report, 14 Apr. 1985 - 1 Apr. 1986
Jeremy K. Burdett 1 Apr. 1986 4 p
(Contract N00014-85-K-0354)
(AD-A166385) Avail: NTIS HC A02/MF A01 CSCL 20/12

The dielectric theory of Phillips and Van Vechten defines crystalline ionicity in terms of optical properties and predicts first-order structural phase transitions. Their approach, while very successful, is, nonetheless, empirical and has yet to be justified via an ab initio quantum mechanical approach. We present such an approach for examining the relationship between spectroscopic crystal ionicity and spatial structure. We demonstrate that the structural predictions based on ionicity scales derived from the dielectric theory are consistent with a microscopic point of view. Pseudopotential radii are used to sort ternary systems. By and large the sorting is only slightly better than that found using ionic radii, although the use of a third parameter allows sorting of the spinel and Cr3S4 types. GRA

N86-30531# Rockwell International Corp., Anaheim, Calif. Science Center.
FERROELECTRIC TUNGSTEN BRONZE CRYSTALS FOR FAR INFRARED ELECTRO-OPTIC DEVICE APPLICATIONS Final Report, 12 Jan. 1983 - 30 Sep. 1985
R. R. Neurgaonkar Nov. 1985 47 p
(Contracts DAAK70-83-C-0016; AF Proj. 2131)
(AD-A166484; SC5356.56FR) Avail: NTIS HC A03/MF A01 CSCL 20/2

The primary objective of this research program is to develop for electro-optic and nonlinear optical applications high quality, striation-free crystals of a number of interesting tungsten bronze compositions such as Ba(2-x)Sr(x)K(1-y)Na(y)Nb5O15 (BSKNN), Ba6Ti2Nb8O30 (BTN), and a few compositions which are close to a morphotropic phase boundary, using the Czochralski and edge defined crystal growth techniques. The large transverse and longitudinal electro-optic response obtainable near morphotropic phase boundaries are studied in particular detail for optical device applications. A second objective is to improve material photorefractive performance using selected dopants. Several undoped and doped tungsten bronze BSKNN-1 and BSKNN-2 single crystals have been grown by the Czochralski technique. Optical evaluation shows that both the crystals show minimum striations, and are useful for optical studies. Current growth results suggest that the existence of striations depends on the type of dopant and the purity of starting materials. Both BSKNN-1 and BSKNN-2 crystals show excellent ferroelectric and optical properties which are similar to perovskite BaTiO3 rather than to tungsten bronze SBN:60 single crystals. The unit cells for BSKNN-1 and BSKNN-2 are slightly bigger than SBN:60 crystal and for these small changes their entire ferroelectric properties are different. GRA

N86-30532# Allied Corp., Charlotte, N.C. Synthetic Crystal Products Group.
RESEARCH IN GADOLINIUM SCANDIUM GALLIUM GARNET (GSGG) CRYSTAL DEVELOPMENT Final Report, 1 May - 31 Dec. 1984
Jul. 1985 73 p
(Contract DE-AC08-84DP-40203)
(DE86-004292; DOE/DP-40203/1) Avail: NTIS HC A04/MF A01

The Czochralski growth technique was utilized for the development of a large diameter, laser quality gadolinium, scandium gallium garnet co-doped with neodymium and chromium (Nd:Cr:GSGG). Vary aspects of the development were determinations of raw material purity, foule growth runs, boule composition and lattice parameters, and losses. DOE

N86-30533# Bell Communications Research, Inc., Murray Hill, N.J.
CONTRIBUTIONS OF ELECTRON MICROSCOPY TO THE UNDERSTANDING OF REACTIONS ON COMPOUND SEMICONDUCTOR SURFACES
T. Sands Nov. 1985 19 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with California Univ., Lawrence Berkeley Lab.
(Contract DE-AC03-76SF-00098)
(DE86-005230; LBL-20509; CONF-851217-27) Avail: NTIS HC A02/MF A01

Reacted films on compound semiconductor substrates present challenging materials characterization problems which often require the application of transmission electron microscopy (TEM) techniques. In this paper, both the problem-solving potential of the TEM techniques and the limits imposed by preparation of thin film/compound semiconductor TEM specimens are discussed. Studies of the Ni/GaAs, CuCl(aq)/CdS and Pd/GaAs reactions exemplify the role of TEM in identifying and determining the spatial distribution of interface-stabilized polymorphs and new ternary phases (e.g., tetragonal CuS, NiGaAs and Pd/sub x/GaAs). These examples also serve to clarify the relationship between TEM and complementary analysis techniques such as Rutherford backscattering spectrometry, Auger electron spectroscopy and glancing-angle x-ray diffraction. In particular, it is argued that a combination of (1) high-spatial-resolution information obtained by TEM and (2) an indication of the average behavior provided by data from a complementary characterization technique provide the minimum quality and quantity of data necessary to understand most reactions on compound semiconductor substrates. DOE

N86-30534# Argonne National Lab., Ill.
POINT DEFECTS AND HIGH-TEMPERATURE DEFORMATION OF NIO
K. C. Goretta and J. L. Routbort 1985 9 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract W-31-109-eng-38)
(DE86-005560; CONF-851217-30) Avail: NTIS HC A02/MF A01

The steady-state flow stress tau(sub s) in nonstoichiometric NiO single crystals has been measured in the temperature range of 1428 to 1653 K with oxygen partial pressures p(O2) between 6 and 1 x 10 to the 5th power Pa. Strain rates epsilon were varied from 1 x 10 to the -5 power to 2 x 10 to the -3 power/sec. Transmission electron microscopy indicates that dislocation climb is the primary mechanism of recovery. Because dislocation climb is diffusion controlled, the data may be described at fixed temperature by epsilon = A tau(sub s)(sup n) p(O2)(sup 1/m), where n is the stress exponent and m is a parameter that is determined by the dominant atomic defects on each sublattice. At high temperatures and p(O2) > 2 x 10 to the 4th power Pa, n was found to be in agreement with dislocation-climb models; however, n increased at low p(O2) owing to effects of impurities. The values of m are consistent with control of climb rate by diffusion of singly charged oxygen vacancies for low p(O2) and by diffusion of neutral oxygen interstitials for high p(O2). At lower temperatures, the values of n are strongly affected by dislocation/impurity interactions for all p(O2). DOE

N86-30535# State Univ. of New York, Stony Brook. Dept. of Materials Science and Engineering.
LIGHT-INDUCED EXCESS CONDUCTIVITY AND THE ROLE OF ARGON IN THE DEPOSITION OF DOPING-MODULATED AMORPHOUS SILICON SUPERLATTICES
F. C. Su, S. Levine, P. E. Vanier (Brookhaven National Lab., Upton, N. Y.), and F. J. Kampas 1985 6 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Brookhaven National Lab., Upton, NY.
(Contract DE-AC02-76CH-00016)
(DE86-005812; BNL-37573; CONF-851217-39) Avail: NTIS HC A02/MF A01

Amorphous semiconductor superlattice structures consisting of alternating n-type and p-type doped layers of hydrogenated amorphous silicon (a-Si:H) have been made by silane glow discharge in a single chamber system. These multilayered films show the novel phenomenon of light-induced excess conductivity (LEC) associated with a metastable state having a lifetime on the order of days. This report shows that the LEC effect is quite dependent on the specific details of the deposition parameters, namely dilution of the silane with inert gas, substrate temperature and layer thickness. In order to investigate the origin of the LEC effect, argon dilution was used for specific regions of the structure. This experiment shows that the slow states are distributed throughout the layers, and are not concentrated at the interfaces. DOE

N86-30536# Exxon Research and Engineering Co., Annandale, N.J. Corporate Research Science Lab.
MICROSTRUCTURAL DYNAMICS OF PRIMARY AND SECONDARY RECRYSTALLIZATION
M. P. Anderson, G. S. Grest, and D. J. Srolovitz (Los Alamos National Lab., N. Mex.) 1985 18 p Presented at the Computer Simulation of Microstructural Evolution Symposium, Toronto, Ontario, 14 Oct., 1985 Prepared in cooperation with Los Alamos National Lab., NM.
(Contract W-7405-eng-36)
(DE86-006046; LA-UR-86-421; CONF-8510273-1) Avail: NTIS HC A02/MF A01

Monte Carlo computer simulation techniques have been applied to the problem of recrystallization in a two dimensional matrix. Both primary and secondary recrystallization are investigated. Primary recrystallization is modelled under conditions where the degree of stored energy is varied and nucleation occurs either continuously as a function of time or as site saturated. The degree of stored energy is adjusted to range from heterogeneous nucleation at grain edges and corners to homogeneous nucleation throughout the microstructure. Secondary recrystallization is modelled: (a) where the driving force is provided solely by curvature and (b) where the driving force is provided by the difference in the solid-vapor surface energy between grains of different crystallographic orientation. The role of particles in initiating secondary recrystallization is also addressed. The microstructure and kinetics for the different recrystallization processes are discussed and compared. DOE

N86-30537# Kuo and Associates, McLean, Va.
ION IMPLANTATION AND LASER ANNEALING
1986 5 p
(Contract DE-AC01-85ER-30078)
(DE86-006226; DOE/ER-30078/T3) Avail: NTIS HC A02/MF A01

Three ion implantation and laser annealing projects have been performed by ORNL through the DOE sponsored Seed Money Program. The research has contributed toward improving the characteristics of wear, hardness, and corrosion resistance of some metals and ceramics, as well as the electrical properties of semiconductors. The work has helped to spawn related research, at ORNL and elsewhere, concerning the relationships between microstructure and materials properties. ORNL research has resulted in major advances in extended life and non-corrosive artificial joints (hip and knee), high performance semiconductors, failure resistant ceramics (with potential energy applications), and

solar cells. The success of the seed money projects was instrumental in the formation of ORNL's Surface Modification and Characterization Facility (SMAC). More than 60 universities and companies have participated in SMAC programs. DOE

N86-30538# Brookhaven National Lab., Upton, N. Y.
FLUX PINNING BY GRAIN BOUNDARIES IN A15 SUPERCONDUCTORS
D. O. Welch, M. Suenaga, C. L. Snead, Jr., and R. D. Hatcher (Queens Coll., Flushing, N. Y.) 1985 4 p Presented at the International Symposium on Flux Pinning and Electromagnetic Properties in Superconductors, Fukuoka, Japan, 11 Nov. 1985 Prepared in cooperation with Queens Coll., Flushing, NY.
(Contract DE-AC02-76CH-00016)
(DE86-006250; BNL-37574; CONF-8511126-3) Avail: NTIS HC A02/MF A01

The form of the scaling law for flux pinning by grain boundaries in A15-structure compounds, primarily in the case of Nb3Sn and its alloys, is discussed, and the effect of alloying and radiation damage on the pinning strength is compared with predictions of the electron-scattering theory of the elementary pinning force. In addition, some preliminary results of 2-dimensional computer simulations are discussed in relation to the observed effects of alloying on the form of the scaling law for Nb3Sn. DOE

N86-30539# Naval Research Lab., Washington, D. C.
THEORY OF ELECTRONIC STATES IN DISORDERED ALLOY HYDRIDES
D. A. Papaconstantopoulos, P. M. Laufer, and A. C. Switendick 1985 16 p Presented at the North Atlantic Treaty Organization Advanced Study Institute, Heraklion Crete, Greece, 16 Sep. 1985 Prepared in cooperation with Naval Research Lab., Washington, DC.
(Contract DE-AC04-76DP-00789)
(DE86-006260; SAND-85-2633C; CONF-8509175-2) Avail: NTIS HC A02/MF A01

Band structure calculations of metal hydrides have provided understanding of the bonding characteristics of these materials and clarified the mechanisms involved in various physical properties such as superconductivity. This article focuses on the methodology and results of disordered hydrides (TiFeH(sub x), transition-metal dihydrides, Pd-noble metal hydrides). This disorder can occur on the metal site of the hydride by considering random substitutions of the host metal or on the hydrogen sublattice where vacancies appear. The theory used is based on the coherent potential approximation and proceeds as follows. Self-consistent band structure calculations of typical metal hydrides are performed by the augmented plane wave method. Results are fitted to a tight-binding Hamiltonian using a Slater-Koster type of procedure. This Hamiltonian is then used in a tight-binding version of the coherent potential approximation which gives us the electronic densities of states for different metal and hydrogen compositions. DOE

N86-30540# California Univ., Berkeley. Lawrence Berkeley Lab.
EFFECTS OF 500 keV ELECTRON IRRADIATION AND SUBSEQUENT ANNEALING ON 1/f NOISE IN COPPER FILMS
J. Pelz and J. Clarke Oct. 1985 7 p Presented at the 8th International Conference on Noise in Physical System and 4th International Conference on 1/f Noise, Rome, Italy, 9 Sep. 1985
(Contract DE-AC03-76SF-00098)
(DE86-002954; LBL-20385; CONF-8509249-1) Avail: NTIS HC A02/MF A01

Polycrystalline copper films were maintained at 90K on the cold stage of an electron microscope and irradiated with 500keV electrons to induce defect. With an electron dose of about 5 x 10(20)cm(-2), the spectral density of the noise voltage across the films increased by an order of magnitude while the electrical resistivity increased by at most 10%. The films were annealed at progressively higher temperatures; after each annealing process the 1/f noise and resistivity were remeasured at 90K. Both the 1/f noise and resistivity were reduced, but at the lower annealing temperatures the fractional reduction in the added noise was substantially more than in the added resistivity. These results suggest that a large fraction of the added noise may be generated by a small mobile fraction of the added defects that are more readily annealed than the majority of the defects. After a room temperature annealing process, both the noise and resistivity returned nearly to their initial values. The temperature dependence of the noise after irradiation and partial annealing was consistant with the Dutta-Dimon-Horn thermal activation model. DOE

N86-30541# Exxon Research and Engineering Co., Annandale, N.J. Corporate Research Science Lab.
COMPUTER SIMULATION OF MICROSTRUCTURAL DYNAMICS
G. S. Grest, M. P. Anderson, and D. J. Srolovitz 1985 13 p Presented at the Computer Simulation of Microstructural Evolution Symposium, Toronto, Ontario, 14 Oct. 1985 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE86-006045; LA-UR-86-420; CONF-8510273-2) Avail: NTIS HC A02/MF A01

Since many of the physical properties of materials are determined by their microstructure, it is important to be able to predict and control microstructural development. A number of approaches have been taken to study this problem, but they assume that the grains can be described as spherical or hexagonal and that growth occurs in an average environment. We have developed a new technique to bridge the gap between the atomistic interactions and the macroscopic scale by discretizing the continuum system such that the microstructure retains its topological connectedness, yet is amenable to computer simulations. Using this technique, we have studied grain growth in polycrystalline aggregates. The temporal evolution and grain morphology of our model are in excellent agreement with experimental results for metals and ceramics. DOE

N86-30542# New Mexico Univ., Albuquerque.
ELECTRICAL CHARACTERISTICS AND TESTING CONSIDERATIONS FOR GATE OXIDE SHORTS IN CMOS ICs
C. F. Hawkins and J. M. Soden 1985 13 p Presented at the International Test Conference, Philadelphia, Pa., 19 Nov. 1985 Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE85-016168; SAND-85-0705C; CONF-851130-1) Avail: NTIS HC A02/MF A01

This paper examines the electrical characteristics and testing considerations of gate oxide shorts. Gate oxide shorts will cause increased IDD and in the majority of cases will degrade logic voltage levels and propagation delay times, but may not affect functionality. Stuck-at and functional models are therefore inadequate for testing gate oxide shorts in CMDS ICs unless they are used in conjunction with IDD measurements. DOE

N86-30543# Oak Ridge National Lab., Tenn.
ROLE OF INTERFACES IN CAVITY FORMATION
M. H. Yoo and H. Trinkaus 10 Oct. 1985 29 p Presented at the ASM Metals Congress/TMS-AIME Fall Meeting, Toronto, Ontario, 13 Oct. 1985
(Contract DE-AC05-84OR-21400)
(DE86-004763; CONF-8510160-14) Avail: NTIS HC A03/MF A01

Nucleation of intergranular and interfacial cavities in two-phase materials during deformation at elevated temperatures is examined using a classical nucleation model under time-dependent vacancy supersaturation. Various potential sites of cavity nucleation in structural alloys are reviewed. A predictive capability for the propensity of cavity nucleation is developed on the basis of the mobilities of dislocations involved in the stress concentration and relaxation process. If the mobility of interfacial dislocations at two-phase interfaces is increased to a level close to that of grain-boundary dislocations, cavity formation in two-phase materials can be generally suppressed. DOE

N86-30544# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Physics.
HIGH PRESSURE ELECTRON RESONANCE STUDIES OF ELECTRONIC, MAGNETIC AND STRUCTURAL PHASE TRANSITIONS Final Technical Report, 1 May 1982 - 30 Apr. 1984
Joe H. Fifer and Mark C. Croft Jun. 1985 13 p
(Contract DE-AS05-82ER-12061)
(DE85-016971; DOE/ER-12061/3) Avail: NTIS HC A02/MF A01

The construction and testing of a high pressure (100 kbar) X-band electron resonance probe capable of operating down to 1.5 K has been completed. The probe design differs radically from a conventional EPR cavity system and also from the design of other high pressure EPR systems. The pressure is generated by a gasketed diamond anvil cell. The pressure gasket is a rectangular BeCu plate whose length is one half of the microwave wavelength (3 cm). The gasket thus acts as a resonant antenna to receive and store the microwave energy which is transmitted to the gasket by a waveguide that passes through the center of the pressure cell. The waveguide can be rotated relative to the resonator to allow ortical coupling. The diamond anvils, gasket, and sample are supported at the center of the waveguide on sapphire posts. Force is applied to the cell by a differential screw which permits the pressure to be changed while the diamond cell is at low temperature. Pressure calibration is carried out at low temperature using the pressure induced shift of a ruby fluorescence line. Author

N86-30545# Argonne National Lab., Ill. Fusion Power Program.
ELASTIC AND INELASTIC SURFACE EFFECTS ON ION PENETRATION AND THE RESULTING SPUTTERING AND BACKSCATTERING
A. M. Hassanein and D. L. Smith 1985 16 p
(DE85-016604; CONF-850813-1) Avail: NTIS HC A02/MF A01

The computer code ITMC (Ion Transport in Materials and Compounds) has been developed to study in detail the transport of charged particles in solid materials and surfaces related phenomena such as sputtered atoms and backscattered ions. The code is based on Monte Carlo methods to follow the path and the damage produced by the charged particles in three dimension as they slow down in target materials. Single-element targets as well as alloys with possible different surface and bulk compositions or with layered structures of different materials can be used. Various models developed to calculate the inelastic energy losses with target electrons can be used in the code. Most known interatomic potentials can also be used to calculate the elastic energy losses. The major advantages of the code are its ability and flexibility to use and compare various models of elastic and inelastic energy losses in any target with different compounds and different surface and bulk compositions. Author

N86-30546# Rockwell International Science Center, Thousand Oaks, Calif. Science Center.
ELECTROCHEMICAL PHOTOCAPACITANCE SPECTROSCOPY OF AMORPHOUS SILICON ALLOY MATERIALS Annual Subcontract Report, 1 Jun. 1984 - 30 Sep. 1985
R. Haak Jan. 1986 41 p
(Contract DE-AC02-83CH-10093)
(DE86-004421; SERI/STR-211-2888) Avail: NTIS HC A03/MF A01

The goal of this work was to develop electrochemical photocapacitance spectroscopy (EPS) as an analytical tool to map the energy-level distributions and concentrations of intrabandgap states of hydrogenated amorphous silicon (a-Si:H) and amorphous silicon alloy thin-film materials. EPS should contribute to improving a-Si materials by identifying film deposition condiditons or approaches to eliminate or reduce the number of such states. The emphasis of this work was on optimizing EPS measurement conditions and determining the quantitative accuracy of EPS for this particular sample type; applying EPS to a-Si:H and alloy samples acquired from various sources; and investigating light-induced effects on intrabandgap state levels. Results show that EPS is indeed a simple, sensitive means of evaluating intrabandgap, i.e., dangling bond states, in both p-i and p-i-n a-Si:H materials/devices and p-i-n a-Si:Ge:H devices. DOE

N86-30547# Sandia National Labs., Albuquerque, N. Mex.
PROCEEDINGS OF THE SECOND WORKSHOP ON ION MIXING AND SURFACE LAYER ALLOYING
Jan. 1986 219 p Workshop held at Pasadena, Calif., 19 Apr. 1985 Prepared in cooperation with Argonne National Lab., Ill. and California Inst. of Tech., Pasadena
(Contract DE-AC04-76DP-00789)
(DE86-006159; SAND-85-2465; CONF-8504116) Avail: NTIS HC A10/MF A01

The intent was to bring together, in an informal setting, those individuals whose work deals with ion mixing and high dose ion implantation. Primary objectives of the workshop were to discuss the basic physical processes underlying ion mixing, compare the approach of ion mixing to that of high dose ion implantation, assess the areas of greatest practical applications for ion mixing, and identify critical areas on which future investigations should focus. The meeting also afforded an opportunity to evaluate progress in the various areas over the past two years. The workshop was primarily concerned with ion mixing phenomena observed for ion energies of about 50 to 500 keV, because accelerators designed for ion implantation in semiconductors are readily available in this energy range. DOE

N86-30548# Sandia National Labs., Albuquerque, N. Mex.
ANOMALOUS BEHAVIOR DURING THE SOLIDIFICATION OF SILICON IN THE PRESENCE OF IMPURITIES
M. O. Thompson and P. S. Peercy Dec. 1985 13 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Cornell Univ., Ithaca, N.Y.
(Contract DE-AC04-76DP-00789)
(DE86-007395; SAND-85-1405C; CONF-851217-53) Avail: NTIS HC A02/MF A01

Nanosecond pulsed laser irradiation of silicon results in the melting of the surface with subsequent solidification from a crystalline substrate. In the presence of impurities or alloys, the solidification dynamics are greatly affected by the nature of the impurities. Five classes of materials have been investigated: amorphous Si, mutually soluble alloys, high solubility impurities, low solubility impurities, and compound forming materials. Solidification of each of these classes of materials is discussed. Several anomalous kinetic regimes are observed, including explosive crystallization, surface nucleation of solid, and internal nucleation of melt. These results are interpreted in terms of thermodynamic modifications of the melting temperature in the alloy regions. DOE

N86-30549# California Univ., Berkeley. Lawrence Berkeley Lab.
TOPICS IN PRECIPITATION AND ORDERING REACTIONS AND THEIR RELATED PHENOMENA
K. H. Westmacott and U. Dahmen Dec. 1985 19 p Presented at the International Symposium on Behavior or Lattice Imperfections in Materials: In Situ Experiments with HVEM, Osaka, Japan, 18 Nov. 1985
(Contract DE-AC03-76SF-00098)
(DE86-007483; LBL-20460; CONF-8511159-2) Avail: NTIS HC A02/MF A01 CSCL 05/9

The application of high voltage electron microscopy to the study of phase transformations is illustrated with a number of examples of precipitation reactions (Al-Si; Al-Ge; Fe-Cu; Pt-C; Fe-N). The importance of lattice defects is emphasized and it is shown how strain accommodation is accomplished for various types of transformations. DOE

N86-30550# California Univ., Berkeley. Lawrence Berkeley Lab.
STRUCTURE AND ELECTRICAL PROPERTIES OF Au CONTACTS TO GaAs
Z. Liliental-Weber, N. Newman, W. E. Spicer, R. Gronsky, J. Washburn, and E. R. Weber Nov. 1985 10 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Stanford Univ., Calif.
(Contract DE-AC03-76SF-00098)

(DE86-007499; LBL-20618; CONF-851217-56) Avail: NTIS HC A02/MF A01

The structure and electrical properties of Au contacts to GaAs have been studied by analytical and high-resolution transmission electron microscopy (TEM) combined with electrical characterization and photoemission spectroscopy (PES). The contacts were prepared by in-situ deposition of Au onto ultra-high vacuum cleaved n-GaAs (110) surfaces. The effects of annealing on the electrical, morphological and chemical properties of the Au:GaAs contacts were studied. It was shown that the formation of Schottky contacts is correlated with the change in stoichiometry of the GaAs substrate near the Au/GaAs interface. The change to Ohmic behavior for the samples annealed above Au-Ga eutectic was explained by leakage currents at the periphery of the devices. TEM micrographs of the structures revealed the existence of elongated Au crystallites on the GaAs surface at the periphery of the contacts. These leakage currents were eliminated by removing the current path at the periphery using a mesa-etch. DOE

N86-30551# IIT Research Inst., Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
CRYSTALLINE SURFACTANT DISPERSIONS BY RADIO FREQUENCY ABSORPTION
S. H. Tedder Mar. 1986 26 p
(Contract DE-FC22-83FE-60149)
(DE86-000267; NIPER-103) Avail: NTIS HC A03/MF A01

Recently interest has increased in the use of liquid crystalline surfactant dispersions for enhanced oil recovery. The object of the work described in the report was to develop a method of measuring the electrical properties of colloidal surfactant particles, which control the structure and stability of the surfactant dispersion. A further object was to find how these electrical properties are affected by the method used to mix the components of the dispersion. The results may be useful in solving several practical problems, including the identification of optimally performing liquid crystalline surfactant formulations for oil recovery use. Another possible use is to identify and categorize effects of the method of mixing surfactants on the final product. This information would provide guidelines for field handling of chemical recovery agents. The absorption of radio frequency energy, a process which is mediated by the surface electrical properties of the surfactant particles, was used to measure several electrical parameters of the surfactant mixtures. Two commercial petroleum surfactants were tested by the radio frequency absorption method, and a model of their electrical properties was developed and used to fit the data. The strength of the layer of electric charges surrounding the surfactant particles was found to be related to the stability of the solution. DOE

N86-30552# Arizona State Univ., Tempe. Dept. of Physics.
IMAGING OF SURFACES AND DEFECTS OF CRYSTALS Final Technical Report, 1 May 1979 - 30 Nov. 1985
J. M. Cowley Dec. 1985 19 p
(Contract DE-AC02-76ER-02995)
(DE86-008302; DOE/ER-02995/25) Avail: NTIS HC A02/MF A01

The research program has been concerned with the application of new methods for the exploration of the structures, properties and reactions of surfaces with high spatial resolution. The surfaces studied have been those of metals and ceramic oxides. The surface reactions investigated have included the oxidation processes of metals and the interactions of thin films or small particles of metals with oxide surfaces. DOE

N86-30553# Technische Hochschule, Aachen (West Germany). Inst. fuer Theoretische Elektrotechnik.
SELECTIVE LOW-PRESSURE SILICON EPITAXY Final Report, Sep. 1984
Heinz-Juergen Voss and Hans Kuerten Bonn Bundesministerium fuer Forschung und Technologie Dec. 1985 89 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-85-133; ISSN-0340-7608; ESA-86-97436) Avail: NTIS HC A05/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 18.50

Selective epitaxy in the low pressure procedure was investigated. The lateral dielectric insulation of devices is performed by selective low pressure silicon epitaxy. The nucleation of Si on the masking oxide and nitride surface can be prevented by water pretreatment and addition of HCl to the reaction gas. The use of low temperature low pressure epitaxy allows to grow layers with homogeneous thickness within the epitaxial islands as well as among the islands. The formation of facets at the boundary between the masking and the epitaxial layer was studied. Electrical and optical measurements of the crystal quality show that selective epitaxy is suitable for semiconductor devices. ESA

N86-30232*# Texas A&M Univ., College Station. Dept. of Aerospace Engineering.
A COMPARISON OF CURRENT MODELS FOR NONLINEAR RATE-DEPENDENT MATERIAL BEHAVIOR OF CRYSTALLINE SOLIDS M.S. Thesis
Joachim Michael Beek *In its* Integrated Research in Constitutive Modelling at Elevated Temperatures, Part 1 Jun. 1986 148 p
(For primary document see N86-30227 21-39)
Avail: NTIS HC A15/MF A01 CSCL 20K

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N86-30554*# California Univ., Los Angeles. School of Engineering and Applied Science.
DYNAMICS INSULATION SYSTEMS
W. E. W. Chen, W. A. Hepler, S. W. K. Yuan, and T. H. K. Frederking Oct. 1985 38 p
(Grant NAG2-253)
(NASA-CR-177026; NAS 1.26:177026; UCLA-ENG-8532) Avail: NTIS HC A03/MF A01 CSCL 20M

Advanced dynamic insulation systems were analyzed from a thermodynamic point of view. A particular performance measure is proposed in order to characterize various insulations in a unique manner. This measure is related to a base quantity, the refrigeration power ratio. The latter is the minimum refrigeration power, for a particular dynamic insulation limit, to the actual reliquefaction power associated with cryoliquid boiloff. This ratio serves as reference quantity which is approximately constant for a specific ductless insulation at a chosen normal boiling point. Each real container with support structure, vent tube, and other transverse components requires a larger refrigeration power. The ratio of the actual experimental power to the theoretical value of the support-less system is a suitable measure of the entire insulation performance as far as parasitic heat leakage is concerned. The present characterization is illustrated using simple thermodynamic system examples including experiments with liquid nitrogen. Numerical values are presented and a comparison with liquid helium is given. M.G.

N86-30555*# Stanford Univ., Calif. Dept. of Physics.
HIGH ACCURACY HEAT CAPACITY MEASUREMENTS THROUGH THE LAMBDA TRANSITION OF HELIUM WITH VERY HIGH TEMPERATURE RESOLUTION Final Report, 1 Sep. 1980 - 31 Aug. 1983
William M. Fairbanks and John A. Lipa Apr. 1984 51 p
(Grant NAG2-62)
(NASA-CR-177037; NAS 1.26:177037) Avail: NTIS HC A04/MF A01 CSCL 20M

A measurement of the heat capacity singularity of helium at the lambda transition was performed with the aim of improving tests of the Renormalization Group (RG) predictions for the static

thermodynamic behavior near the singularity. The goal was to approach as closely as possible to the lambda-point while making heat capacity measurements of high accuracy. To do this, a new temperature sensor capable of unprecedented resolution near the lambda-point, and two thermal control systems were used. A short description of the theoretical background and motivation is given. The initial apparatus and results are also described. B.G.

N86-30556*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STABILITY OF SURFACE NUCLEATION
Joshua Salik Aug. 1986 9 p
(NASA-TM-88806; E-3154; NAS 1.15:88806) Avail: NTIS HC A02/MF A01 CSCL 20H

The growth and decomposition rates of nuclei on a surface are expressed in microscopic terms. A stability factor is defined and employed for the derivation of a criterion for nucleus stability. Simulation results indicate that the stability factor can be used as a measure of the system stability. Author

N86-30557# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemical and Environmental Engineering.
EFFECT OF INTERFACIAL PHENOMENA ON CONTACT LINE HEAT TRANSFER, 1 Annual Report, 1 Oct. 1984 - 30 Sep. 1985
Peter C. Wayner, Jr. 20 Oct. 1985 9 p
(Grant AF-AFOSR-0306-84)
(AD-A166088; AFOSR-86-0084TR) Avail: NTIS HC A02/MF A01 CSCL 20/13

The heat transfer characteristics of the contact line region of an evaporating thin liquid film were studied experimentally and theoretically. The effects of composition and temperature gradients on surface shear were analyzed and the results were successfully compared with previously reported experimental trends. The use of a constant vapor pressure boundary condition allowed the relative effects of surface tension, composition and temperature on fluid flow to be mapped. A small heat transfer cell was designed, built and used on the scanning stage of a scanning microphotometer. The unique use of a microphotometer allows the microscopic detail to be measured. The preliminary results are being analyzed to evaluate the effect of capillarity on the evaporating meniscus in heat pipes. Additional development work on the heat transfer cell is required. Modeling studies are being extended. GRA

N86-30558# California Univ., Santa Barbara. Quantum Inst.
A GAUSSIAN WAVE PACKET METHOD FOR STUDYING TIME DEPENDENT QUANTUM MECHANICS IN A CURVE CROSSING SYSTEM: LOW ENERGY MOTION, TUNNELING AND THERMAL DISSIPATION Annual Technical Report
Shin-Ichi Sawada and Horia Metiu Feb. 1986 89 p
(Contract N00014-81-K-0598)
(AD-A166262; TR-7) Avail: NTIS HC A05/MF A01 CSCL 20/10

We explore numerically the behavior of a method of describing the time dependent quantum mechanics of a curve crossing system. The two nuclear wave functions corresponding to the two electronic states are each described by a Gaussian wave packet. The packet describing the incident state mimics the initial wave function, and the other packet is created by the time dependent Schroedinger equation. They are both propagated by using a variational method. The packets interact and we do not assume that they have a small width. Exploratory calculations are made for curve crossing dynamics at low kinetic energy above the barrier of the lowest adiabatic state, for tunneling, for multiple crossings, and for a curve crossing system which is strongly coupled to a harmonic bath whose motion is described by a mean trajectory classical Langevin method. GRA

N86-30559# Lawrence Livermore National Lab., Calif.
DEVELOPMENT OF ACCURATE ESTIMATION METHODS FOR CALCULATING HEAT CAPACITIES OF REFRACTORY MATERIALS
O. H. Krikorian Dec. 1985 11 p Presented at the 1st Asian Thermophysical Properties Conference, Beijing, China, 21 Apr. 1986
(Contract W-7405-eng-48)
(DE86-004242; UCRL-93198; CONF-860474-1) Avail: NTIS HC A02/MF A01

Factors that contribute to the heat capacities of solids are analyzed and correlation methods are developed for accurately estimating these factors for the refractory borides, carbides, nitrides, and oxides. High temperature heat capacities calculated for the borides are found to agree with experiment to within +/3%. DOE

N86-30560# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
ON EXPERIMENTS TO DETECT POSSIBLE FAILURES OF RELATIVITY THEORY
W. A. Rodrigues, Jr. and J. Tiomno 1985 39 p
(DE86-700613; CBPF-NF-009/85) Avail: NTIS (US Sales Only) HC A03/MF A01

Two recently proposed experiments by Kolen and Torr designed to show failures of Einstein's Special Relativity (SR) are analysed. It is pointed out that these papers contain a number of imprecisions and misconceptions which are cleared out. Also the very spread of misconception about anisotropy of propagation of light in vacuum in Lorentz Aether Theory (LAT) is analysed showing that the anisotropy is only a coordinate effect. Comparison of the correct results in LAT theory, leading to violation of SR, with new theoretical and experimental results of Torr et al is made. Some of these new results are shown to be incorrect and/or inconsistent with both SR and LAT. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N86-30561# Universal Energy Systems, Inc., Dayton, Ohio.
UNITED STATES AIR FORCE SUMMER FACULTY RESEARCH PROGRAM MANAGEMENT REPORT, 1985 Annual Report
Rodney C. Darrah and Susan K. Espy Dec. 1985 284 p
(Contract F49620-85-C-0013)
(AD-A166175; AFOSR-86-0138TR) Avail: NTIS HC A13/MF A01 CSCL 14/2

The Graduate Student Summer Support Program (GSSSP) is conducted as part of the Summer Faculty Research Program as the Air Force Office of Scientific Research. The program provides opportunities for research in the physical sciences, engineering, life sciences, business, and administrative sciences. The program has been effective in providing basic research opportunities to the Graduate Students of universities, colleges, and technical institutions throughout the United States. The program is available to Graduate Students enrolled in either Masters Degree or Doctorate Programs. It has proven especially beneficial to the students who are starting their academic research programs. Beginning with the 1982 program, research opportunities were provided for 17 graduate students. The 1982 pilot student program was highly successful and was expanded in 1983 to 53 students; there were 84 graduate students in the 1984 program. This document lists the participants and abstracts of their research completed on this project. GRA

N86-30562# Universal Energy Systems, Inc., Dayton, Ohio.
UNITED STATES AIR FORCE SUMMER FACULTY RESEARCH PROGRAM, 1985 TECHNICAL REPORT, VOLUME 1 Annual Report
Rodney C. Darrah and Susan K. Espy Dec. 1985 199 p
(Contract F49620-85-C-0013)
(AD-A166176; AFOSR-86-0139TR-Vol-1) Avail: NTIS HC A09/MF A04 CSCL 05/9

The United States Air Force Graduate Student Summer Support Program (USAF-GSSSP) is conducted under the United States Air Force Summer Faculty Research Program. The program provides funds for selected graduate students to work at an appropriate Air Force Facility with a supervising professor who

holds a concurrent Summer Faculty Research Program appointment or with a supervising Air Force Engineer. The specific objectives of the 1985 USAF-GSSSP are: To provide a productive means for the graduate students to participate in research at the Air Force Weapons Laboratory; To stimulate continuing professional association among the Scholars and their professional peers in the Air Force; To further the research objectives of the United States Air Force; To enhance the research productivity. This three volume document is a compilation of the final reports written by the assigned students members about their summer research efforts. GRA

N86-30563# Universal Energy Systems, Inc., Dayton, Ohio.
UNITED STATES AIR FORCE SUMMER FACULTY RESEARCH PROGRAM, 1985 TECHNICAL REPORT, VOLUME 2 Annual Report
Rodney C. Darrah and Susan K. Espy Dec. 1985 437 p
(Contract F49620-85-C-0013)
(AD-A166177; AFOSR-86-0140TR-Vol-2) Avail: NTIS HC A19/MF A05 CSCL 05/1

The United States Air Force Graduate Student Summer Support Program (USAF-GSSSP) is conducted under the United States Air Force Summer Faculty Research Program. The program provides funds for selected graduate students to work at an appropriate Air Force Facility with a supervising professor who holds a concurrent Summer Faculty Research Program appointment or with a supervising Air Force Engineer. The specific objectives of the 1985 USAF-GSSSP are: To provide a productive means for the graduate students to participate in research at the Air Force Weapons Laboratory; To stimulate continuing professional association among the Scholars and their professional peers in the Air Force; To further the research objectives of the United States Air Force; To enhance the research productivity. This second volume of a three volume set presents 50 final reports on a wind range of topics of interest to the Air Force, from Optimum design of structures with multiple contraints to ATR performance vs image measurements. GRA

N86-30564# Universal Energy Systems, Inc., Dayton, Ohio.
UNITED STATES AIR FORCE SUMMER FACULTY RESEARCH PROGRAM 1985 TECHNICAL REPORT, VOLUME 3 Annual Report
Rodney C. Darrah and Susan K. Espy Dec. 1985 47 p
(Contract F49620-85-C-0013)
(AD-A166178; AFOSR-86-0141TR-Vol-3) Avail: NTIS HC A03/MF A03 CSCL 05/9

The United States Air Force Graduate Student Summer Support Program (USAF-GSSSP) is conducted under the United States Air Force Summer Faculty Research Program. The program provides funds for selected graduate students to work at an appropriate Air Force Facility with a supervising professor who holds a concurrent Summer Faculty Research Program appointment or with a supervising Air Force Engineer. The specific objectives of the 1985 USAF-GSSSP are: To provide a productive means for the graduate students to participate in research at the Air Force Weapons Laboratory; To stimulate continuing professional association among the Scholars and their professional peers in the Air Force; To further the research objectives of the United States Air Force; To enhance the research productivity. This final volume of a three volume set presents 51 final reports ranging from topics like Blast propagation through a composite wall section to Heat transfer correlation for nosetip with stagnation point gas injection. GRA

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N86-30565# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
DECISION PROCESSES IN INFLUENCE DIAGRAMS: FORMULATION AND ANALYSIS Ph.D. Thesis
Joseph A. Tatman 1985 165 p
(AD-A166327; AFIT/CI/NR-86-24D) Avail: NTIS HC A08/MF A01 CSCL 05/1

This thesis addresses the problem of extending influence diagram theory such that decision processes can be effectively modeled within this graphical modeling language. Specifically, the extension allows value function separability and the principle of optimality to be captured in an influence diagram and then used in analysis. To accomplish this, the concept of a subvalue node has been developed. The set of value preserving operations on influence diagrams have been expanded to include operations that exploit the presence of these nodes. Also an algorithm has been developed to solve influence diagrams with subvalue nodes. This work is important from two perspectives. From the decision analysis perspective, it allows a full and simple exploitation of all separability in the value function of a decision problem. Importantly, this means that algorithms can be designed to solve influence diagrams that automatically recognize the opportunity for applying the the principle of optimality. From the decision processes perspective, influence diagrams with subvalue nodes allow efficient formulation and solution of nonstandard decision processes. Also it allows the conditional independence among the variables in the problem to be exploited. This significantly reduces the data storage requirements and computational complexity of solving the problem. Finally, the influence diagram with subvalue nodes enhances the understanding of many of the critical characteristics of various decision processes. GRA

N86-30566# Air Command and Staff Coll., Maxwell AFB, Ala.
A PROGRAM MANAGER'S GUIDE ON MULTIYEAR PROCUREMENT
Clinton J. Asbury, III Apr. 1986 38 p
(AD-A166463; ACSC-86-0130) Avail: NTIS HC A03/MF A01 CSCL 15/5

Multiyear procurement (MYP) is an acquisition strategy that can stabilize weapon system procurement and reduce program costs through economic production rates. This guide is oriented toward government program managers and other system program office representatives interested in the application of MYP to their program. It explains the concept of MYP, gives a brief history, walks through an example, tracks MYP legislation, and describes the criteria for MYP approval and where it can best be applied. GRA

N86-30567# Department of Energy, Washington, D. C.
SMALL BUSINESS INNOVATION RESEARCH. ABSTRACTS OF PHASE 2 AWARDS, 1985
1985 35 p
(DE86-005392; DOE/ER-0209-1) Avail: NTIS HC A03/MF A01

Contained in this booklet are abstracts of the Phase II awards made in 1985 under the Small Business Innovation Research (SBIR) program in the Department of Energy (DOE). This program, now completing its third year, was established in compliance with the Small Business Innovation Development Act of 1982, Public Law 97-219. The DOE received 844 proposals in response to its annual program solicitation, and on July 13, 1984, 106 were selected for Phase I funding. The Phase II SBIR program competition was limited to the 101 of these that subsequently proceeded to Phase I contracts and awards. Proposers desiring to maintain project funding continuity from Phase I to Phase II were invited to submit their proposals to DOE not later than February 15, 1985, approximately 6 weeks before the end of their Phase I contracts. Thirty four Phase II proposals were submitted by that date and 13 were selected for Phase II awards; those projects were then able to continue without funding interruption between Phases I and II. The deadline for the submission of Phase II proposals for proposers not seeking to maintain project funding continuity was May 15, 1985. From the 57 proposals submitted by this date and from the 21 unfunded proposals from the February 15 submissions, 33 were selected for Phase II awards. The 46 Phase projects described herein consists of these 33 projects and the 13 projects that were funded from the February 15 submissions. DOE

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

N86-30568*# National Aeronautics and Space Administration. Lyndon B Johnson Space Center, Houston, Tex.
SCIENTIFIC AND TECHNICAL PAPERS PRESENTED OR PUBLISHED BY JSC AUTHORS IN 1985
Aug. 1986 111 p
(NASA-TM-58273; S-553; NAS 1.15:58273) Avail: NTIS HC A06/MF A01 CSCL 05B

The Lyndon B. Johnson Space Center contributions to the scientific and technical literature in aerospace and life sciences made during calendar year 1985 are described. Citations include NASA formal series reports, journal articles, conference and symposium presentations, papers published in proceedings or other collective works, and seminar and workshop results. Author

N86-30569*# National Aeronautics and Space Administration, Washington, D.C.
NASA THESAURUS SUPPLEMENT
May 1986 150 p
(NASA-SP-7053-Supp-1; NAS 1.21:7053-Supp-1) Avail: NTIS HC A07 CSCL 05B

The four cumulative NASA Thesaurus Supplement to the 1985 edition of the NASA Thesaurus includes Part 1, Hierarchical Listing, Part 2, Access Vocabulary, Part 3, NASA Thesaurus Definitions, and Part 4, Changes. The semiannual supplement gives complete hierarchies for new terms. Author

N86-30570# Defense Technical Information Center, Alexandria, Va. Office of Information Systems and Technology.
THE DoD GATEWAY INFORMATION SYSTEM: PROTOTYPE EXPERIENCE Final Report
Gladys A. Cotter Apr. 1986 9 p
(AD-A166200; DTIC/TR-86/6) Avail: NTIS HC A02/MF A01 CSCL 05/2

The Department of Defense (DoD) Research and Engineering community requires rapid, easy access to scientific and technical information relevant to its mission. This information is contained in a multiplicity of databases maintained within the federal and commercial sectors. The DoD Gateway Information System (DGIS) is being developed to provide this community with a modern tool for accessing these databases and extracting information products from them. DGIS is designed to provide the DoD researcher with a single, user-friendly system front-end that can be used to identify, access, interrogate, and post-process information from numerous databases. The DGIS transforms these database and processing resources into a single entity - a virtual database. The Defense Technical Information Center (DTIC) is responsible for managing the design, development, and implementation of DGIS. A prototype version of DGIS is now undergoing test and evaluation. Eight information services have been selected as targets of the prototype gateway. The utility of DGIS will rest on the early acceptance and wide spread participation of users. The design accommodates, transparent to the user, the complexities of accessing, downloading, merging, and processing information from diverse sources. This paper describes DGIS developments and evaluations to date.
GRA

N86-30571# Massachusetts Inst. of Tech., Cambridge. School of Management.
DESIGN OF A DATA STORAGE HIERARCHY DSH-I2: SOFTWARE AND HARDWARE
Michael J. Abraham Mar. 1986 120 p
(Contract N00039-83-C-0463)
(AD-A166287; M010-8603-19; TR-19) Avail: NTIS HC A06/MF A01 CSCL 09/2

Modern organizations are becoming increasingly reliant on the storage and processing of very large data bases in support of their accounting, operational control, and high-level decision-making functions. Contemporary Data Base Management Systems are capable of handling data bases on the order of a trillion bits of data, and can process transactions at rates of up to 100 queries per second. However, it is expected that future high-performance DBM's will be required to provide storage capacities and transaction rates several orders of magnitude greater than those of any current systems. It is not unreasonable to project requirements of a quadrillion bits and one million database accesses per second. This report presents a refined set of control algorithms which take advantage of theoretical properties of INFOPLEX-like storage systems. Section 2 presents an overview of the INFOPLEX design issues and tradeoffs related to performance and reliability, and develops a general strategy for efficient READ/WRITE control and reliable fault handling. Section 3 develops the functional design of D SH-III in more detail, including functional descriptions of the system components and their interfaces. GRA

N86-30572# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCIENTIFIC AND TECHNICAL INFORMATION SEARCH AND SERVICE IN THE RESEARCH AND DEVELOPMENT OF MILITARY PRODUCTS
Xiu C. Wang 28 Mar. 1986 15 p Transl. into ENGLISH from Quingbao Kexue (China), v. 5, no. 3, Jun. 1984 p 65-67
(AD-A166300; FTD-ID(RS)T-0883-85) Avail: NTIS HC A02/MF A01 CSCL 05/2

Combining working experiences, the relation of search and service of technical information and research and development of military products, the necessity of the support of strategic and tactic information, and their relation are clarified. The special features of technical information of military products and the channels to obtain such information are also clarified. These include a flow chart of research and development foreign information, tactical information, searching for information and editing. Several important stages of technical information search and service are discussed in the end of this paper. GRA

N86-30573# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
THE ROLE OF DATABASES IN KNOWLEDGE-BASED SYSTEMS Interim Report
Mark S. Fox and John McDermott Feb. 1986 29 p
(Contract F49620-82-K-0017)
(AD-A166365; CMU-RI-TR-86-3) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper explores the requirements for database (DB) techniques in the construction of knowledge-based systems (KBS). While early work in Artificial Intelligence (AI) has focused on techniques such as representation and problem-solving, scant attention was paid to the issues to which database research has focused (e.g., data sharing, query optimization, transaction processing). Our principal premise is that although it has appeared that there was little intersection between the particular focus of each group, there is a significant overlap in needs. The maturing of AI techniques has recently led to their application outside of the laboratory, thus thrusting upon them problems requiring DB solutions. On the other hand, DB needs have expanded to include more expressive data models and more powerful query languages (e.g., supporting inference). To ascertain KBS requirements for DBs, three KBSs are described. Each is analyzed from the perspective of the symbol and knowledge level concepts developed by Newell NEWE81. Limitations inherent in this perspective are identified. A new level, the organization level, is proposed as a means of identifying and dealing with these limitations. Three knowledge-based systems are reviewed: XCON/R1, ISIS, and Callisto. GRA

N86-30574# Hughes Aircraft Co., Long Beach, Calif. Support Systems.
ARTIFICIAL INTELLIGENCE INDEXING: CREATING KNOW-

LEDGE BASES OF INDEX TERMS ORDERED BY SEMANTIC RELATIONS Final Report, 2 Jun. - 12 Dec. 1985
Jay J. Myers, David Y. Kamemoto, and Arthur F. Griffin Dec. 1985 34 p
(Contract DAAK21-85-C-0031)
(AD-A166768; HDL-CR-85-031-1) Avail: NTIS HC A03/MF A01 CSCL 05/2

This report summarizes an investigation of concepts related to the development of intelligent, automated text indexing. It discusses the construction of knowledge bases of index terms and semantic relations extracted from several different types of full-text documents. Approaches to automating this indexing process are examined, including work related to semantic knowledge representation, knowledge engineering, natural language understanding, and semantic inferencing. This research was conducted using a software package which uses semantic networks both for representing knowledge and for displaying a graphical data base. An approach to language processing is outlined which does not require a large lexicon but instead makes use of high-frequency, low-content words supplemented with knowledge of key verbs and generic and domain-specific seed knowledge. This approach uses word order, prepositions, and word endings to determine parts of speech, to identify index terms, and to infer the semantic relations among objects, modifiers, actions, and attributes. The parameters of the requisite seed knowledge and a framework for representing and making use of verb knowledge are described. This artificial intelligence approach to indexing is contrasted with human indexing performance.
Author (GRA)

N86-30575# Army Engineer Topographic Labs., Fort Belvoir, Va.
GIS (GEOGRAPHIC INFORMATION SYSTEM)-BASED APPLICATIONS WITH A WORLDWIDE DATABASE
K. Kurtz and T. E. Jorgensen 1985 8 p
(AD-A166825; ETL-R-077) Avail: NTIS HC A02/MF A01 CSCL 05/2

This presentation will deal with difficulties associated with developing GIS-based applications programs capable of being used worldwide, or for a significant portion of the world. Issues discussed will include data format requirements, on- and off-lone storage requirements, coordinate and datum transformation problems, and the need to write software which can be easily used by an operator who may not be an expert in Geographic Information System (GIS) operation or in a particular discipline for which the software is based. Alternate solutions to the problems will be presented, and trade-offs involved in the various solutions, with respect to the issues mentioned above, will be discussed. GRA

N86-30576# Los Alamos National Lab., N. Mex.
TRANSLATION TABLE FOR DOE/OSTI - COSATI BIBLIOGRAPHIC RECORDS TO MARC FORMAT RECORDS
K. Gursky, I. Holtkamp, S. Landenberger, C. Ostrander, C. Nook, M. Shanks, and M. Hall Nov. 1985 65 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex., ORNL, Tenn. and DOE, Oak Ridge, Tenn.
(DE86-006473; DOE/TIC-4639; LA-UR-86-136) Avail: NTIS HC A04/MF A01

This report contains the recommendations of the committee for the conversion of data in OSTI fields to MARC fields. It is intended as a tool for OSTI to use in developing software that would enable DOE libraries to download OSTI records into MARC-based systems. Goal is to transfer as complete a set of data for each record as possible. No attempt was made to incorporate changes in the use of numerical tags that OSTI has made over the years. In addition, there are a few OSTI fields generated for internal OSTI use only, or that cannot be transferred into any MARC field in the Books format; these OSTI fields have been designated as not converted in the table. DOE

N86-30577# Boeing Co., Seattle, Wash.
RECORDS, DOCUMENTATION STORAGE AND RETRIEVAL SYSTEM, PHASE 2 Interim Report
1986 99 p
(DE86-007219; DOE/NBM-6007219) Avail: NTIS HC A05/MF A01

This interim report defines a documentation storage and retrieval system to be implemented, with any necessary modifications, by the Bonneville Power Administration. Also included is a configuration management system based upon specific change flows and change controls utilizing a change board. The body of the report is divided into three sections as follows: Management Summary, Operating Procedures, and Implementation Plan. DOE

N86-30578# Stanford Linear Accelerator Center, Calif.
INTRODUCTION TO THE FASTBUS
D. B. Gustavson Dec. 1985 12 p Presented at the BUSCON Conference, San Jose, Calif., 14 Jan. 1986
(Contract DE-AC03-76SF-00515)
(DE86-005830; SLAC-PUB-3844; CONF-860142-1) Avail: NTIS HC A02/MF A01

The Fastbus is a modular data bus system for data acquisition and data processing. It is a multiprocessor system with multiple bus segments which operate independently but link together for passing data. It operates asynchronously to accommodate very high and very low speed devices over long or short paths, using handshake protocols for reliability. It can also operate synchronously with pipelined handshakes for transfer of data blocks at maximum speed. The goals, history and motivation for the Fastbus are summarized briefly. The structure of the Fastbus system is described in general and some details of its operation are introduced. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N86-30579*# Mechanical Technology, Inc., Latham, N. Y. Stirling Engine Systems Div.
AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM Semiannual Progress Report, 1 Jul. - 31 Dec. 1985
W. Ernst, A. Richey, R. Farrell, G Riecke, G. Smith, R. Howarth, M. Cronin, M. Simetkosky, and J. Meacher May 1986 66 p
(Contracts DEN3-32; DE-AI01-85CE-50112)
(NASA-CR-175045; NAS 1.26:175045; Rept-86ASE507SA9; DOE/NASA-0032/80-7) Avail: NTIS HC A04/MF A01 CSCL 13F

This is the ninth Semiannual Technical Progress Report prepared under the Automotive Stirling Engine Development

Program. It covers the twenty-eighth and twenty-ninth quarters of activity after award of the contract. Quarterly Technical Progress Reports related program activities from the first through the thirteenth quarters; thereafter, reporting was changed to a Semiannual format. This report summarizes the study of higher-power kinematic Stirling engines for transportation use, development testing of Mod I Stirling engines, and component development activities. Component development testing included successful conical fuel nozzle testing and functional checkout of Mod II controls and auxiliaries on Mod I engine test beds. Overall program philosophy is outlined and data and test results are presented.
Author

N86-30580*# National Aeronautics and Space Administration, Washington, D.C.
HUNGARIAN SPACE RESEARCH 1981-1985: LECTURES AND REVIEW ARTICLES
Gyorgy Benko, ed. Jul. 1986 11 p Transl. into ENGLISH from proceedings of the Scientific Session of the Intercosmos Council of the Hungarian Academy of Sciences, 1986 Conference held in Budapest, Hungary, 1986 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-87992; NAS 1.15:87992; ISBN-963-372-392-2) Avail: NTIS HC A02/MF A01 CSCL 05A

This monograph presents an overview of Hungarian space research from 1981 to 1985. Topics discussed in the original report include the development of space research centers, the flight of the first Hungarian astronaut, Hungarian participation in international space programs such as the Vega/Halley's Comet mission and the BEALUCA materials science experiment, advances in astronomical research, and activities of the Cosmic Geodetic Observatory. Other topics discussed include space biomedical studies, meteorological applications of space research, satellite communications, and satellite power supply systems.
Author

N86-30581# Essex Corp., Goleta, Calif. Human Factors Research Div.
TECHNOLOGY TRANSFER AND ARTIFICIAL INTELLIGENCE
Robert R. Mackie and C. D. Wylie Dec. 1985 147 p
(Contract N62269-83-D-0115)
(AD-A166035; TR-51231-1) Avail: NTIS HC A07/MF A01 CSCL 05/1

The purpose of this study was to identify critical user acceptance issues in applying artificial intelligence (AI) technology (e.g., expert systems) to military decision aids, and to develop a technology transfer plan. The application of new technology does not necessarily yield a good product, and even good products do not necessarily succeed on their own merits. Product development and introduction must consider the perspectives of potential users, especially when use of the innovation can be regarded as optional. The officers generally expressed optimism about the potential value of AI. However, negative beliefs held by many officers need to be considered carefully. A number of general design issues were identified, and several man-machine interface preferences were determined, including the desire for: display of historical data on request; use of probability estimates; embedded training and on-line tutorial; auto mode settings with user override; easy updating; suggestive rather than authoritative output; and brief rather than conversational output. A technology transfer plan based on the findings of this study is presented which stresses communications with potential users, involvement of users in design, design for acceptance, and demonstration.
GRA

N86-30582# Army War Coll., Carlisle Barracks, Pa.
TRANSFER OF HIGH-TECHNOLOGY TO THE SOVIET UNION. A PREDICAMENT FOR THE US
John E. Holland, Jr. 21 Mar. 1986 29 p
(AD-A166469) Avail: NTIS HC A03/MF A01 CSCL 15/4

Through reading Western open-source literature and by international purchases of U.S. computers and electronics, the Soviets have been able to modernize their military forces. This raises the question, Should U.S. technology be in the public domain and available for exploitation by the Soviet Union? The scope of Soviet information gathering operations raises concerns about the true Russian motivation for detente. Complicating the technology-transfer issue has been the prevailing attitude that parity promotes stability among world powers. As a result of this philosophy, the United States has found itself restrained from acquiring a significant technology advantage over the Soviet Union. The U.S. finds itself in the predicament of both needing a technology edge yet being unable to have a significant one. Thus, ensuring that the Soviets are not able to apply U.S. technology too quickly becomes an important aspect of the technology-transfer solution. Although technology controls are expensive and require the commitment of the American public, they are necessary. Should the Soviets gain technological parity, Then the U.S. would be compelled to match Soviet conventional forces to ensure that Russian expansionism is equally restrained.
GRA

N86-30583# Los Alamos National Lab., N. Mex.
INSTITUTIONAL SUPPORTING RESEARCH AND DEVELOPMENT, 1985
H. Motz, comp. Feb. 1986 83 p
(Contract W-7405-eng-36)
(DE86-008580; LA-10600) Avail: NTIS HC A05/MF A01

This report presents 25 articles on projects currently supported by the Institutional Supporting Research and Development Program at Los Alamos National Laboratory. Articles are grouped into several categories: chemistry and materials sciences, life sciences, geosciences and space physics, techniques/instrumentation/devices, and physics. Much of the work reported here relies on multi-disciplinary approaches; it encompasses not only basic research but also important, technically challenging applied research relevant to the Laboratory's mission.
DOE

88 SPACE SCIENCES (GENERAL)

N86-30584*# Lunar and Planetary Inst., Houston, Tex.
TRAJECTORY DETERMINATIONS AND COLLECTION OF MICROMETEOROIDS ON THE SPACE STATION. REPORT OF THE WORKSHOP ON MICROMETEORITE CAPTURE EXPERIMENTS
Friedrich Hoerz, ed. 1986 105 p refs Workshop held in Houston, Tex., 16-18 Dec. 1985
(Contract NASw-4066)
(NASA-CR-177303; NAS 1.26:177303; LPI-TR-86-05) Avail: NTIS HC A06/MF A01 CSCL 03B

Summaries of papers presented at the Workshop on Micrometeorite Capture Experiments are compiled. The goals of the workshop were to define the scientific objectives and the resulting performance requirements of a potential Space Station facility and to identify the major elements of a coherent development program that would generate the desired capabilities within the next decade. Specific topics include cosmic dust and space debris collection techniques, particle trajectory and source determination, and specimen analysis methods. For individual titles, see N86-30585 through N86-30607.

N86-30585*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AN IN-SITU MEASUREMENT OF PARTICULATES FROM SOLID ROCKET MOTORS FIRED IN SPACE c20
John W. Alred *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 43-44 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

Current models exist that predict the damage caused by the impact of aluminum oxide exhaust particles as well as their lifetime in useable space. In these models, two necessary inputs are the size and flux of the particles. An experiment, referred to as the Plume Witness Plate, was designed for the Remote Manipulator System of the space shuttle orbiter to measure in-situ the flux

and material effects of a solid rocket motor (SRM) firing in space. Five different types of samples were used to provide a broad range of substances: (1) fused quartz glass (representative of orbiter windows); (2) germanium micrometeroid capture cells; (3) orbiter HRTS tiles from the thermal protection system; (4) Kapton foil; and (5) metallic disks of aluminum, copper, titanium, graphite epoxy, and gold. The analyses of the data show excellent agreement with ground-based SRM firings in terms of particle size distribution and mass distribution. The Particle Impact Damage Integrator computer model used to calculate potential damage of orbiter surfaces by SRM exhaust plumes agrees favorable with the results in terms of particle size and velocity distributions though it may be conservative by as much as 20%. M.G.

N86-30586*# McCrone Research Inst., Chicago, Ill.
THIN-SECTIONING AND MICROANALYSIS OF INDIVIDUAL EXTRATERRESTRIAL PARTICLES c90
J. P. Bradley *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 45-46 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

A long standing constraint on the study of micrometeorites has centered on difficulties in preparing them for analysis. This is due largely to their small dimensions and consequent practical limitations on sample manipulation. Chondritic micrometeorites provide a good example; although much has been learned about their chemistry and mineralogy almost nothing was known about such basic properties as texture and petrographic associations. The only way to assess such properties is to examine microstructure indigenous to the particles. Unfortunately, almost all micrometeorites, out of necessity, have been crushed and dispersed onto appropriate substances prior to analysis, and most information about texture and petrography was lost. Recently, thin-sections of individual extraterrestrial particles have been prepared using an ultramicrotome equipped with a diamond knife. This procedure has been applied to stratospheric micrometeorites and Solar Max impact debris. In both cases the sections have enabled observation of a variety of internal particle features, including textures, porosity, and petrographic associations. The sectioning procedure is described and analysis results for chondritic micrometeoroids and select particles from Solar Max are presented. M.G.

N86-30587*# Washington Univ., St. Louis, Mo. Dept. of Physics.
INTERPLANETARY DUST: THE INTERSTELLAR CONNECTION c90
William C. Carey and Robert M. Walker *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 47-48 refs (For primary document see N86-30584 21-88)
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Although not proven, there is the widespread belief that comets consist, at least in part, of interstellar material that was originally present in the solar nebula. Furthermore, there are strong arguments in favor of the view that much of the interplanetary dust complex is derived from comets. The main arguments supporting this view are based on mass balance, analysis of the orbital parameters of meteors, and the long known association between meteor showers and specific comets. Laboratory measurements on interplanetary dust particles (IDPs) collected in the stratosphere have confirmed the view that many of the dust particles are primitive in the sense that they show striking enrichments of D/H relative to average solar system materials. It has also been demonstrated that the mid-infrared absorption spectra of one infrared red class of particles show strong similarities to IR sources such as the protostar W-33A. However, the laboratory studies of IDPs have shown that they represent a diverse set of objects and the measurement of the orbital parameters of specific dust particles is essential to answering the question of sources. The observation of the IRAS dust bands reopens the question of the role of asteroids in supplying a significant fraction of the dust and part of the diversity observed may be due to the fact that some of the dust is asteroidal and some cometary. In addition, some fraction of interplanetary dust must consist of an interstellar component intercepted by the solar system in its motion through the local interstellar medium. It has been shown that dust derived from nearby stars will have 75% of their orbits with eccentricities < or equal to 1.1 and might be difficult to distinguish from interplanetary dust based on orbital measurements alone. M.G.

N86-30588*# Washington Univ., St. Louis, Mo. Dept. of Physics.
PROSPECTS FOR AN ORBITAL DETERMINATION AND CAPTURE CELL EXPERIMENT c90
William C. Carey and Robert M. Walker *In* Lunar and Planetary Inst. Trajectory Determinations and Collections of Micrometeoroids on the Space Station 1986 p 49-51 refs (For primary document see N86-30584 21-88)
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A dust experiment which combines measurements of the elemental and isotopic composition of individual particles with orbital information would contribute fundamental, new scientific information on the sources contributing to the micrometeoroid population. The general boundary conditions for such a system are: (1) it must be capable of measuring velocities in the range of 10 km/sec to 100 km/sec with several percent accuracy; (2) it must collect particles in such a way that the debris atoms are locally concentrated so that precise isotopic measurements are possible; (3) it should collect particles over a wide range of sizes starting with a lower limit of 10 microns; (4) it should incorporate materials that will not compromise the isotopic measurements; and (5) it should be large enough to obtain statistically meaningful results within a reasonable exposure time. Techniques which may satisfy these conditions are described. M.G.

N86-30589*# Northwestern Univ., Evanston, Ill. Astronomical Research Center.
THE USE OF TETHERED SATELLITES FOR THE COLLECTION OF COSMIC DUST AND THE SAMPLING OF MAN MADE ORBITAL DEBRIS FAR FROM THE SPACE STATION c18
G. J. Corso *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 52-53 refs Prepared in cooperation with Loyola Univ., Chicago, Ill. (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

The use of a tethered subsatellite employed downward into the earth's upper atmosphere to an altitude of about 110 km above the earth would eliminate the orbital contamination problem while at the same time affording a measure of atmospheric braking to reduce the velocities of many particles to where they may be captured intact or nearly so with properly designed collectors. The same technique could also be used to monitor the flux of all types of man-made orbital debris out to a distance of more than a hundred kilometers in any direction from the space station. In this way the build up of any debris belt orbiting earth could be determined. The actual collecting elements used for both purposes could be of several different materials and designs so as to optimize the collection of different types of particles with different densities. Stacks of foils, films, plastics, and foams, as well as simple capture cells would be mounted in clusters around the outside of a tethered satellite and protected by iris covers until the tethered had been fully deployed. If the orientation history of the satellite were known the direction of the incoming material could be infered. A chief advantage in deploying such tethered collectors from the Space Station instead of from the shuttle is the ability to maintain deployment of the tether for days instead of hours resulting in much greater yields of intact particles and impact debris. M.G.

N86-30590*# Chicago Univ., Ill. Lab. for Astrophysics and Space Research.
A NEW INSTRUMENT TO MEASURE CHARGED AND NEUTRAL COMETARY DUST PARTICLES AT LOW AND HIGH IMPACT VELOCITIES c35
T. Economon, J. A. Simpson, and A. J. Tuzzolino *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of

Micrometeoroids on the Space Station 1986 p 54-55 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

A new class of dust particle detector, the PVDF dust detector, was designed for space missions such as the Halley Comet missions where the particle impact velocity is very high. It is demonstrated that this same PVDF detector (operating in a different mode) also has the capability of detecting dust particles having low velocity (approx. 100 m/s). This low velocity detection capability is extremely important in terms of planned missions requiring measurement of low velocity dust particles such as comet rendezvous missions. An additional detecting element (charge induction cylinder) was also developed which, when combined with a PVDF detector, yields a system which will measure the charge (magnitude and sign) carried by a cometary particle as well as the particle velocity and mass for impact velocities in the range 100 to 500 m/s. Since the cylinder-PVDF detector system has a relatively small geometry factors, an array of PVDF detectors was included having a total sensing area of 0.1 sq m for measurements in regions of space where the dust flux is expected to be low. The characteristics of the detectors in this array have been chosen to provide optimum mass sensitivity for both low-velocity cometary dust as well as high-velocity asteroid associated and interplanetary dust. Author

N86-30591# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LASER MICROPROBE STUDY OF COSMIC DUST (IDPS) AND POTENTIAL SOURCE MATERIALS **c90**
E. K. Gibson, Jr. and M. S. Sommer, II *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 56-57 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

The study of cosmic dust or interplanetary dust particles (IDP) can provide vital information about primitive materials derived primarily from comets and asteroids along with a small unknown fraction from the nearby interstellar medium. The study of these particles can enhance our understanding of comets along with the decoding of the history of the early solar system. In addition the study of the cosmic dust for IDP particles can assist in the elucidation of the cosmic history of the organogenic elements which are vital to life processes. Studies to date on these particles have shown that they are complex, heterogeneous assemblages of both amorphous and crystalline components. In order to understand the nature of these particles, any analytical measurements must be able to distinguish between the possible sources of these particles. A study was undertaken using a laser microprobe interfaced to a quadrupole mass spectrometer for the analysis of the volatile components present in cosmic dust particles, terrestrial contaminants present in the upper atmosphere, and primitive carbonaceous chondrites. From the study of the volatiles released from the carbonaceous materials it is hoped that one could distinguish between components and sources in the IDP particles analyzed. The technique is briefly described and results for the CI, CM, and CV chondrites and cosmic dust particle W7027B8 are presented. M.G.

N86-30592*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HYPERVELOCITY PARTICLE CAPTURE: SOME CONSIDERATIONS REGARDING SUITABLE TARGET MEDIA **c90**
Friedrich Horz, Mark J. Cintala, and Thomas H. See (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 58-60 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

Hypervelocity particles colliding with passive capture media will be traversed by shock waves; depending on the stress amplitude, the particle may remain solid or it may melt or vaporize. Any capture mechanism considered for cosmic dust collection in low Earth-orbit must be designed such that sample alteration and hence loss of scientific information is minimized. Capture of pristine particles is fundamentally difficult, because the specific heat of melting and even vaporization is exceeded upon impact at typical, geocentric encounter velocities. From the results of calculated and observed melting behaviors it is concluded that shock stresses in excess of 50 GPA should be avoided during hypervelocity particle capture on board Space Station and that stresses < 20 GPa, even at 15 km/s collision velocities, should constitute desirable instrument design goals. Some principal characteristics of the capture medium that may satisfy these requirements are identified. M.G.

N86-30593*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ORBITAL DEBRIS MEASUREMENTS **c90**
D. J. Kessler *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 61-63 refs (For primary document see N86-30584 21-88)
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What is currently known about the orbital debris flux is from a combination of ground based and in-space measurements. These measurements have revealed an increasing population with decreasing size. A summary of measurements is presented for the following sources: the North American Aerospace Defense Command Catalog, the Perimeter Acquisition and Attack Characterization System Radar, ground based optical telescopes, the Explorer 46 Meteoroid Bumper Experiment, spacecraft windows, and Solar Max surfaces. Author

N86-30594*# Technische Univ., Munich (West Germany). Institut fuer Luft-und Raumfahrt.
ACOUSTIC PENETRATION AND IMPACT DETECTOR FOR MICROMETEOROID AND SPACE DEBRIS APPLICATION **c90**
H. Kuzcera, H. Igiseder, U. Weishaupt, and E. Igenbergs *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 64-66 refs (For primary document see N86-30584 21-88)
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The Two-Stage Acoustic Penetration and Impact Detector is a simple device for measuring the impact event time, the projectile velocity, the flight path direction and the momentum. The results of laboratory tests have shown that this detector can be used in a wide range of projectile size and velocity. According to measurement purposes the size of the detection area, the distance between the front foil and the target plate and the number of microphones as well as the evaluation procedure can easily be adjusted. The target plate area can also be replaced by another foil detector, if two penetration stages are preferred. This active detector is suitable for a variety of applications in meteoroid and space debris exploration. It can also be supplied with capture cell properties for chemical analysis of inside-deposits. Therefore, this measurement principal has been taken into consideration as a possible flight experiment for instance for a later Longer Duration Exposure Facility (LDEF) flight or future space station activities. Author

N86-30595*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
EFFECTS OF THE LOW EARTH ORBITAL ENVIRONMENT ON SPACECRAFT MATERIALS Abstract Only **c18**
Lubert J. Leger *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 67 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

It is evident from space flights during the last three years that the low Earth orbital (LEO) environment interacts with spacecraft surfaces in significant ways. One manifestation of these interactions is recession of, in particular, organic-polymer-based surfaces presumably due to oxidation by atomic oxygen, the major component of the LEO environment. Three experiments have been conducted on Space Shuttle flights 5, 8 and 41-G to measure reaction rates and the effects of various parameters on reaction rates. Surface recession on these flights indicates reaction efficiencies approximately 3 x 10(-24) cu cm/atoms for unfilled

organic polymers. Of the metals, silver and osmium are very reactive. Effects on spacecraft or experiment surfaces can be evaluated using the derived reaction efficiencies and a definition of the total exposure to atomic oxygen. This exposure is obtained using an ambient density model, solar activity data and spacecraft parameters of altitude, attitude and operational date. Oxygen flux on a given surface is obtained from the ambient density and spacecraft velocity and can then be integrated to provide the total exposure or fluence. Such information can be generated using simple computational programs and can be converted to various formats. Overall, the extent of damage is strongly dependent on the type of surface and total exposure time. Author

N86-30596*# New Mexico Univ., Albuquerque. Dept. of Geology.

STRATOSPHERIC DUST COLLECTIONS: VALUABLE RESOURCES FOR SPACE AND ATMOSPHERIC SCIENTISTS c46

Ian D. R. Mackinnon *In* Lunar and Planetary Inst. Trajectory Determination and Collection of Micrometeoroids on the Space Station 1986 p 68-69 refs (For primary document see N86-30584 21-88)

Avail: NTIS HC A06/MF A01 CSCL 03B

The stratospheric collection at the Johnson Space Center Curatorial Facility offers a unique opportunity to study well-documented, individual particles (or groups of particles) from a wide variety of sources. The nature of the collection and curation process, as well as the timeliness of some sampling periods, ensures that all data obtained from stratospheric particles is a valuable resource for scientists from a wide range of disciplines. A few samples of the uses of these stratospheric dust collections are outlined. An understanding of global parameters at a particular point in time in the stratosphere can be obtained from a study of complete collection surfaces. For example, an accurate assessment of particle concentration over a wide range of sizes was experimentally determined for the stratospheric cloud formed one month after the eruption of El Chichon. Additional studies on the El Chichon cloud over a six-month period showed that volcanic ash settles out of the stratosphere at a rate determined primarily by particle shape and density. Another study during a volcanically quiescent period has shown that total particle number density during the summer of 1981 was approx. 2.7 x 10(-1) cm(-3), for particles $>$ 1 micron diameter. However, $>$ 95% of these particles were $<$ 5 micrometers diameter. With the above classification scheme, an estimate of micrometeorite number density at 20km altitude can also be made. Continuation of these types of studies, for shorter collection periods at regular intervals, can provide important experimental data on the contributions of orbital debris, rocket firings and transient events on the total stratospheric particle budget. Author

N86-30597*# New Mexico Univ., Albuquerque. Dept. of Geology.

TARGETED FLIGHT OPPORTUNITIES WITH LARGE AREA COLLECTORS c46

Ian D. R. Mackinnon *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 70-71 refs (For primary document see N86-30584 21-88)

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A major factor in the stratospheric collection process is the relative density of particles at the collection altitude. With current aircraft-borne collector plate geometries, one potential extraterrestrial particle of about 10 micron diameter is collected approximately every hour. However, a new design for the collector plate, termed the Large Area Collector (LAC), allows a factor of 10 improvement in collection efficiency over current conventional geometry. The implementation of LAC design on future stratospheric collection flights will provide many opportunities for additional data on both terrestrial and extraterrestrial phenomena. With the improvement in collection efficiency, LAC's may provide a suitable number of potential extraterrestrial particles in one short flight of between 4 and 8 hours duration. Alternatively, total collection periods of approximately 40 hours enhance the probability that rare particles can be retrieved from the stratosphere. This latter approach is of great value for the cosmochemist who may wish to perform sophisticated analyses on interplanetary dust greater than a picogram. The former approach, involving short duration flights, may also provide invaluable data on the source of many extraterrestrial particles. The time dependence of particle entry to the collection altitude is an important parameter which may be correlated with specific global events (e.g., meteoroid streams) provided the collection time is known to an accuracy of $<$ 2 hours. Author

N86-30598*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE SOLAR MAXIMUM SATELLITE CAPTURE CELL: IMPACT FEATURES AND ORBITAL DEBRIS AND MICROMETEORITIC PROJECTILE MATERIALS c18

D. S. McKay, F. J. M. Rietmeijer (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.), L. S. Schramm, R. A. Barrett, H. A. Zook, and G. E. Blanford (Houston Univ., Clear Lake, Tex.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 72-75 refs (For primary document see N86-30584 21-88)

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The physical properties of impact features observed in the Solar Max main electronics box (MEB) thermal blanket generally suggest an origin by hypervelocity impact. The chemistry of micrometeorite material suggests that a wide variety of projectile materials have survived impact with retention of varying degrees of pristinity. Impact features that contain only spacecraft paint particles are on average smaller than impact features caused by micrometeorite impacts. In case both types of materials co-occur, it is believed that the impact feature, generally a penetration hole, was caused by a micrometeorite projectile. The typically smaller paint particles were able to penetrate though the hole in the first layer and deposit in the spray pattern on the second layer. It is suggested that paint particles have arrived with a wide range of velocities relative to the Solar Max satellite. Orbiting paint particles are an important fraction of materials in the near-Earth environment. In general, the data from the Solar Max studies are a good calibration for the design of capture cells to be flown in space and on board Space Station. The data also suggest that development of multiple layer capture cells in which the projectile may retain a large degree of pristinity is a feasible goal. Author

N86-30599*# National Aeronautics and Space Administration, Washington, D.C.

DUST COLLECTION ON SERVICEABLE SATELLITES c18

Joseph A. Nuth, III *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 76 (For primary document see N86-30584 21-88)

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One rationale for the Space Shuttle program which was dramatically realized during the repair of the Solar Maximum Mission (SMM) is the efficiency of in-orbit satellite servicing. An unexpected benefit of this repair mission was the return of parts of the Solar Max satellite which had been exposed for four years to the space environment. Studies conducted on these parts have yielded valuable data on the micrometeorite flux and composition at shuttle altitudes during this time period. The scientific results from studies of the cosmic dust component of the observed particle impacts are not yet complete but it is clear from the preliminary data available that such studies will be a valuable adjunct to the studies of cosmic dust particles collected in the atmosphere. The success of the initial studies of particles collected during repairs of the SMM spacecraft on a surface not specifically designed as a particle collector nor retrieved in a manner intended to minimize or eliminate local contamination raises the possibility that even more interesting results might be obtained if serviceable satellites were initially designed with these objectives in mind. All designs for modern satellites utilize some form of thermal blanket material in order to minimize thermal stresses inside the spacecraft. It is proposed that all future satellites be designed with standardized removeable

sections of thermal blanket material which could be replaced during on-orbit servicing and returned to earth for detailed study. M.G.

N86-30600*# Evans (Charles) and Associates, Redwood City, Calif.
LASER MICROPROBE CHARACTERIZATION OF C SPECIES IN INTERPLANETARY DUST PARTICLES (IDP) c90
Filippo Radicati diBrozolo, T. E. Bunch (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.), S. Chang, and D. E. Brownlee (Washington Univ., Seattle.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 77-79 (For primary document see N86-30584 21-88)
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Preliminary results of a study whose aim is the characterization of carbon (C) species in microvolumes of materials by means of laser ionization mass spectrometry (LIMS) are presented. The LIMS instrument employs a pulsed UV laser to produce nearly instantaneous vaporization and ionization of materials, followed by acceleration and time-of-flight analysis of the ions produced. LIMS provides a survey technique with nearly simultaneous acquisition of mass spectra covering the entire elemental range. The main limitation of the LIMS technique at present is its limited ability to perform quantitative analysis, due in part to insufficient knowledge of the mechanism of laser-solid interaction. However, considerable effort is now being directed at making LIMS a more quantitative technique. A variety of different C samples, both natural and man made were analyzed to establish the ability of LIMS to differentiate among the various C phases. The results of preliminary analyses performed on meteoritical and interplanetary dust samples are also presented. The C standards selected for the LIMS characterization range from essentially amorphous soot to diamond, which exhibits the highest degree of ordering. M.G.

N86-30601*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
THE IMPORTANCE OF CAPTURING UNMODIFIED CHONDRITIC POROUS MICROMETEORITES ON THE SPACE STATION c90
Frans J. M. Rietmeijer *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 80-82 refs (For primary document see N86-30584 21-88)
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The survival of interplanetary dust particles (IDP's) during deceleration by the Earth's atmosphere is determined by their entry parameters, velocity, size and mass. These IDP's reach their terminal velocity at about 55 to 95 km altitude before they gradually settle to 18 to 21 km altitude where they are collected by high flying aircraft. Chondritic porous IDP's (also called chondritic porous (CP) aggregates) show properties consistent with an extraterrestrial origin. It is conceivable that CP aggregates may be collected above the Earth's atmosphere using capture devices on a space station or satellite. In order to preserve pristine CP aggregates, i.e., aggregates with minimal perturbation or degradation of its particulate matter, it is necessary to transfer the kinetic energy on impact so that a minimum amount of energy is dissipated into the impacting particle. It is likely that low-temperature minerals (e.g., layer silicates), volatile phases (e.g., sulfides), structural defects (e.g. nuclear tracks) and hydrocarbons in CP aggregates are sensitive to the efficiency of kinetic energy dissipation. M.G.

N86-30602*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE STATION c18
David R. Thompson *In* Lunar and Planetary Inst. IN Trajectory Determination and Collection of Micrometeoroids on the Space Station 1986 p 83-84 (For primary document see N86-30584 21-88)
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The Space Station is being defined as a multi-purpose facility with emphasis in the following areas: scientific and technology research laboratory; permanent observatory; spacecraft servicing facility; construction and assembly facility; manufacturing facility; transportation node; and staging base for future space endeavors. The Station complex, in its initial operating capability configuration, includes a continuously habitable manned element, a polar orbiting unmanned platform, and a second unmanned platform co-orbiting with the manned element. All elements are dependent on the Space Transportation System (STS) for initial placement on-orbit and for subsequent logistical services. The manned element will be designed for long duration operations with systems maintainable on-orbit and operationally autonomous from ground control. A major feature of the Station will be its adaptability to evolutionary technology upgrades; and the Space Station, as a system, is to be designed for maximum ease of use by its users. Author

N86-30603*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTACT CAPTURE OF HYPERVELOCITY PARTICLES c90
Peter Tsou, Donald E. Brownlee (Washington Univ., Seattle.), and Arden L. Albee (California Inst. of Tech., Pasadena.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 85-87 refs (For primary document see N86-30584 21-88)
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Knowledge of the phase, structure, and crystallography of cosmic particles, as well as their elemental and isotopic compositions, would be very valuable information toward understanding the nature of our solar system. This information can be obtained from the intact capture of large mineral grains of cosmic particles from hypervelocity impacts. Hypervelocity experiments of intact capture in underdense media have indicated realistic potential in this endeaver. The recovery of the thermal blankets and louvers from the Solar Max spacecraft have independently verified this potential in the unintended capture of cosmic materials from hypervelocity impacts. Passive underdense media will permit relatively simple and inexpensive missions to capture cosmic particles intact, either by going to a planetary body or by waiting for the particles to come to the Shuttle or the Space Station. Experiments to explore the potential of using various underdense media for an intact comet sample capture up to 6.7 km/s were performed at NASA Ames Research Center Vertical Gun Range. Explorative hypervelocity experiments up to 7.9 km/s were also made at the Ernst Mach Institute. These experiments have proven that capturing intact particles at hypervelocity impacts is definitely possible. Further research is being conducted to achieve higher capture ratios at even higher hypervelocities for even smaller projectiles. Author

N86-30604*# Technische Univ., Munich (West Germany). Lehrstuhl fuer Raumfahrttechnik.
COSMIC DUST DETECTION WITH LARGE SURFACE PIEZOCERAMICS c90
U. Weishaupt *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 88-90 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

Piezoelectric transducers mounted on targets made out of metal plates or plastic foils have been used in many former space missions to detect impacting dust particles and to determine some of their parameters (e.g., momentum). The proposed detector is based on a large disc made out of piezoceramic material. Dust particles impacting on the detector will cause electrical charge pulses due to the piezoelectric nature of the target material. These charge pulses are measured on the electrodes of the disc and transformed with a charge sensitive amplifier (CSA) to voltage pulses. Counting the number of pulses leads to the dust-flux impacting on the detector. Additionally the amplitude and the rise time of the pulse slopes are determinated to evaluate the momentum and the size of the dust particles. Due to the high charge production rate per force unit of piezoceramics and momentum transfer without loss the sensivity of this acoustic sensor is very high. A method to derive size and momentum from the rising slope of an acoustic signal is described. M.G.

N86-30605*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MICROMETEOROID DECELERATION AND CAPTURE EXPERIMENT: CONCEPTUAL EXPERIMENT DESIGN DESCRIPTION **c90**
J. H. Wolfe (San Jose State Univ., Calif.), R. W. Ballard, G. C. Carle, and T. E. Bunch *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 91-93 (For primary document see N86-30584 21-88)
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The preliminary conceptual design for a cosmic dust collector is described. For the case of low Earth orbit (LEO), dust particles enter the collector through the collimator at a few volts negative potential due to charging in the ionosphere, at a velocity of 1 to 50 km/sec. The particles then pass through an electron stream and are charged to about 1 KV negative (regardless of incoming polarity). The 1 KV negatively charged particle then passes through three sensing grids coupled to charge sensitive preamps (CSP). The comparison of the two pulses provided by S(1) and S(2) are utilized by the microprocessor to determine the charge, q, on the particle (pulse amplitude) and its velocity, v (by time of flight). The third sensing grid, S(3), is kept at about 20 KV negative so that the dust particle will now be decelerated in passing from S(2) (zero potential) to S(3). S(3) is capacitively coupled to its CSP and the pulse from S(3) is utilized by the microprocessor to determine the particle's energy, E, and therefore its mass, m (again by time of flight) by comparison with the pulses from S(1) and S(2). The microprocessor can now precisely program the high-voltage switching network for the proper timing in the grounding of the successive deceleration grids. As determined by the microprocessor, each successive deceleration grid is grounded just after the dust particle passes, thus reducing the particle's energy by the amount q*100 KV at each stage. The microprocessor also determines at which stage the particle will fall below a certain critical energy where all remaining grids remain unswitched so that the particle will drift to the collector. The collector is kept at about 100V positive and is covered with gold foil to eliminate contamination and is removable for subsequent return to earth for detailed analysis. Author

N86-30606*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CAPACITOR-TYPE MICROMETEOROID DETECTORS **c35**
J. J. Wortman (North Carolina State Univ., Raleigh.), D. P. Griffis (North Carolina Univ., Chapel Hill.), S. R. Bryan, and W. Kinard *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 94-96 refs (For primary document see N86-30584 21-88)
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The metal oxide semiconductor (MOS) capacitor micrometeroid detector consists of a thin dielectric capacitor fabricated on a silicon wafer. In operation, the device is charged to a voltage level sufficiently near breakdown that micrometeoroid impacts will cause dielectric deformation or heating and subsequent arc-over at the point of impact. Each detector is capable of recording multiple impacts because of the self-healing characteristics of the device. Support instrumentation requirements consist of a voltage source and pulse counters that monitor the pulse of recharging current following every impact. An investigation has been conducted in which 0.5 to 5 micron diameter carbonized iron spheres traveling at velocities of 4 to 10 Km/sec were impacted on to detectors with either a dielectric thickness of 0.4 or 1.0 micron. This study demonstrated that an ion microprobe tuned to sufficiently high resolution can detect Fe remaining on the detector after the impact. Furthermore, it is also possible to resolve Fe ion images free of mass interferences from Si, for example, giving its spatial distribution after impact. Specifically this technique has shown that significant amounts of impacting particles remain in the crater and near it which can be analyzed for isotopic content. Further testing and calibration could lead to quantitive analysis. This study has shown that the capacitor type micrometeroid detector is capable of not only time and flux measurements but can also be used for isotopic analysis. M.G.

N86-30607*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PRECISION REQUIREMENTS ON COSMIC DUST TRAJECTORY MEASUREMENTS **c90**
H. A. Zook *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 97-100 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

It has been known for some time that the orbital parameters of certain major meteor streams rather closely match those of presently observed comets. There is therefore a clear parent-daughter orbital relationship between meteoroids in certain streams and the comets that they derived from. For meteoroids in the photographic meteor range, it has been estimated that from 1% to 10% of the meteoroid mass is concentrated into the major streams. However, for the smaller, more numerous meteoroids observed as radar meteors, streams are less intense but there are more of them. Sekanina (1973) has established for the radar meteors that, in addition to comets, some of the parent bodies appear to be asteroids. As noted by Grun et al. (1985), meteoroid lifetimes, due to collisional destruction or Poynting-Robertson (P-R) drag losses, range from 10(5) yr downward to less than 10(3) yr; these meteoroids therefore need to be continuously be replenished by source bodies to maintain the meteoritic complex in some sort of temporal equilibrium. It will be very important to obtain their precise trajectories when meteoroids are collected with a capture apparatus in Earth orbit, as is made apparent with the following logic: a chemical, isotopic, or other analysis of any particular meteoroid constitutes a similarly detailed analysis of a small part of the parent comet or asteroid that is orbitally associated with it. One can, consequently, do rather detailed cometary or asteroid science utilizing only an Earth-orbiting cosmic dust capturing facility. Author

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N86-30608*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
SPACE INFRARED TELESCOPE POINTING CONTROL SYSTEM. AUTOMATED STAR PATTERN RECOGNITION Final Report
J. David Powell and Roel W. H. VanBezooijen Jan. 1985 44 p
(Contract NCC2-2-29)
(NASA-CR-176911; NAS 1.26:176911) Avail: NTIS HC A03/MF A01 CSCL 03A

The Space Infrared Telescope Facility (SIRTF) is a free flying spacecraft carrying a 1 meter class cryogenically cooled infrared telescope nearly three oders of magnitude most sensitive than the current generation of infrared telescopes. Three automatic target acquisition methods will be presented that are based on the use of an imaging star tracker. The methods are distinguished by the number of guidestars that are required per target, the amount of computational capability necessary, and the time required for the complete acquisition process. Each method is described in detail. B.G.

N86-30609*# California Univ., San Diego, La Jolla. Center for Astrophysics and Space Sciences.
DEVELOPMENT OF OPTIMIZED DETECTOR/SPECTROPHOTOMETER TECHNOLOGY FOR LOW BACKGROUND SPACE ASTRONOMY MISSIONS Final Report, 1 Nov. 1982 - 30 Apr. 1985
B. Jones 1985 32 p
(Contract NASw-3702)
(NASA-CR-177142; NAS 1.26:177142; UCSD-488870/26360)
Avail: NTIS HC A03/MF A01 CSCL 03A

This program was directed towards a better understanding of some of the important factors in the performance of infrared detector arrays at low background conditions appropriate for space astronomy. The arrays were manufactured by Aerojet Electrosystems Corporation, Azusa. Two arrays, both bismuth doped silicon, were investigated: an AMCID 32x32 Engineering mosiac Si:Bi accumulation mode charge injection device detector array and a metal oxide semiconductor/field effect transistor (MOS-FET) switched array of 16x32 pixels. Author

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N86-30610*# Cornell Univ., Ithaca, N.Y. Dept. of Physics.
ASTROPHYSICAL MATERIALS SCIENCE: THEORY Final Technical Report
N. W. Ashcroft 1984 13 p
(Grant NAG2-159)
(NASA-CR-177021; NAS 1.26:177021) Avail: NTIS HC A02/MF A01 CSCL 03B

A method of structural expansions for use in determining the equation of state of metallic hydrogen (and indeed other metals) up to the 4th order in the perturbation theory was developed. The electrical and thermal transport properties of the planetary interior of Jupiter were calculated. The nature of the interaction between molecules at short range and the importance of multicenter terms in arriving at an adequate description of the thermodynamic functions of condensed molecular hydrogen were also investigated. B.G.

N86-30611*# California Univ., Santa Cruz.
EVOLUTION OF PRIMORIDAL GAS CLOUDS Final Technical Report, 15 Feb. 1984 - 28 Feb. 1986
Peter H. Bodenheimer Feb. 1986 23 p
(Contract NCC2-281)
(NASA-CR-176959; NAS 1.26:176959) Avail: NTIS HC A02/MF A01 CSCL 03B

The dynamical, chemical, and thermal evolution of zero-metal gas clouds was modeled to study conditions of star formation in the early universe. Numerical results are given for the collapse of spherical clouds of mass 1000 and 50000 solar mass. Cooling by H2 lines and by photons emitted in H + e(-) yields H(-) = h (sup nu) maintains collapse until formation of an equilibrium protostellar core of mass 0.02 solar mass. The cooling by photons produced with H is essential for low mass star formation. If the cloud is fragmented, the evolution of the pieces is similar to that of the parent cloud, but the equilibrium core has larger density and mass. Author

N86-30612*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
THE HYDROGEN COMA OF COMET HALLEY BEFORE PERIHELION: PRELIMINARY OBSERVATIONS WITH DYNAMICS EXPLORER 1
J. D. Craven, L. A. Frank, R. L. Rairden, and M. R. Dvorsky Feb. 1986 17 p Original document contains color illustrations
(Grants NAG5-483; NGL-16-001-002; Contract N00014-85-K-0404)
(NASA-CR-177091; NAS 1.26:177091; IU-86-09) Avail: NTIS HC A02/MF A01 CSCL 03B

The hydrogen coma of Comet Halley has been observed in resonantly scattered solar Lyman-alpha radiation during the period 1-29 January 1986 as the comet approached perihelion. These observations were obtained with the imaging photometer for vacuum-ultraviolet wavelengths on the spacecraft Dynamics Explorer 1. For the initial analysis of observations available in 17 orbits distributed throughout the period, least-squares fits are computed for the observed exponential decrease in brightness with radial distance from the nucleus. Brightness at the nucleus increased from approx. 3 to 17 kR during the observing period. Preliminary analysis yields water production rates of approx. 3.6 x 10 to the 29th power and 1.9 x 10 to the 30th power molecules/sec on 1 and 29 January, respectively. Author

N86-30613# Universidade Estadual de Campinas (Brazil). Inst. de Matematica, Estatistica e Ciencia da Comp
CONSIDERATIONS ABOUT THE APPARENT SUPERLUMINAL EX PANSIONS IN ASTROPHYSICS
E. Recami, A. Castellino (Catania Univ., Italy), G. D. Maccarrone, and M. Rodono 1984 35 p Prepared in cooperation with Catania Univ. (Italy). Ist. di Fisica.
(DE86-701328; UNICAMP-IMECC-RI-278) Avail: NTIS (US Sales Only) HC A03/MF A01

The orthodox models devised to explain the apparent superluminal expansions observed in astrophysics - and here briefly summarized and discussed together with the experimental data - do not seem to be too sucessful, especially when confronted with the most recent observations, suggesting complicated expansion patterns, even with possible accelerations. At this point it may be, therefore, of some interest to explore the possible alternative models in which actual Superluminal motions take place. The ground is prepared starting from a variational principle, introducing the elements of a tachyon mechanics within special relativity, and arguing about the expected behaviour of tachyonic objects when interacting (gravitationally, for instance) among themselves or with ordinary matter. Then the simplest Superluminal models are reviewed and developed, paying particular attention to the observations which they would give rise to. It is concluded that some of them appear to be physically acceptable and are statistically favoured with respect to the orthodox ones. DOE

N86-30586*# McCrone Research Inst., Chicago, Ill.
THIN-SECTIONING AND MICROANALYSIS OF INDIVIDUAL EXTRATERRESTRIAL PARTICLES
J. P. Bradley *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 45-46 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30587*# Washington Univ., St. Louis, Mo. Dept. of Physics.
INTERPLANETARY DUST: THE INTERSTELLAR CONNECTION
William C. Carey and Robert M. Walker *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 47-48 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30588*# Washington Univ., St. Louis, Mo. Dept. of Physics.
PROSPECTS FOR AN ORBITAL DETERMINATION AND CAPTURE CELL EXPERIMENT
William C. Carey and Robert M. Walker *In* Lunar and Planetary Inst. Trajectory Determinations and Collections of Micrometeoroids on the Space Station 1986 p 49-51 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30591# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LASER MICROPROBE STUDY OF COSMIC DUST (IDPS) AND POTENTIAL SOURCE MATERIALS
E. K. Gibson, Jr. and M. S. Sommer, II *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 56-57 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30592*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
HYPERVELOCITY PARTICLE CAPTURE: SOME CONSIDERATIONS REGARDING SUITABLE TARGET MEDIA
Friedrich Horz, Mark J. Cintala, and Thomas H. See (Lockheed

Engineering and Management Services Co., Inc., Houston, Tex.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 58-60 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30593*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ORBITAL DEBRIS MEASUREMENTS
D. J. Kessler *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 61-63 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30594*# Technische Univ., Munich (West Germany). Institut fuer Luft-und Raumfahrt.
ACOUSTIC PENETRATION AND IMPACT DETECTOR FOR MICROMETEOROID AND SPACE DEBRIS APPLICATION
H. Kuzcera, H. Igiseder, U. Weishaupt, and E. Igenbergs *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 64-66 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30600*# Evans (Charles) and Associates, Redwood City, Calif.
LASER MICROPROBE CHARACTERIZATION OF C SPECIES IN INTERPLANETARY DUST PARTICLES (IDP)
Filippo Radicati diBrozolo, T. E. Bunch (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.), S. Chang, and D. E. Brownlee (Washington Univ., Seattle.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 77-79 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30601*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
THE IMPORTANCE OF CAPTURING UNMODIFIED CHONDRITIC POROUS MICROMETEORITES ON THE SPACE STATION
Frans J. M. Rietmeijer *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 80-82 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30603*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INTACT CAPTURE OF HYPERVELOCITY PARTICLES
Peter Tsou, Donald E. Brownlee (Washington Univ., Seattle.), and Arden L. Albee (California Inst. of Tech., Pasadena.) *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 85-87 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30604*# Technische Univ., Munich (West Germany). Lehrstuhl fuer Raumfahrttechnik.
COSMIC DUST DETECTION WITH LARGE SURFACE PIEZOCERAMICS
U. Weishaupt *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 88-90 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30605*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MICROMETEOROID DECELERATION AND CAPTURE EXPERIMENT: CONCEPTUAL EXPERIMENT DESIGN DESCRIPTION
J. H. Wolfe (San Jose State Univ., Calif.), R. W. Ballard, G. C. Carle, and T. E. Bunch *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 91-93 (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

N86-30607*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PRECISION REQUIREMENTS ON COSMIC DUST TRAJECTORY MEASUREMENTS
H. A. Zook *In* Lunar and Planetary Inst. Trajectory Determinations and Collection of Micrometeoroids on the Space Station 1986 p 97-100 refs (For primary document see N86-30584 21-88)
Avail: NTIS HC A06/MF A01 CSCL 03B

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N86-30614*# Lunar and Planetary Inst., Houston, Tex.
PROCEEDINGS OF THE MECA WORKSHOP ON THE EVOLUATION OF THE MARTIAN ATMOSPHERE
Michael Carr, ed., Philip James, ed., Leovy Conway, ed., Robert Pepin, ed., and James Pollack, ed. Aug. 1985 56 p
(Contract NASw-4066)
(NASA-CR-176899; NAS 1.26:176899; LPI-TR-86-07) Avail: NTIS HC A04/MF A01 CSCL 03B

Topics addressed include: Mars' volatile budget; climatic implications of martian channels; bulk composition of Mars; accreted water inventory; evolution of CO2; dust storms; nonlinear frost albedo feedback on Mars; martian atmospheric evolution; effects of asteroidal and cometary impacts; and water exchange between the regolith and the atmosphere/cap system over obliquity timescales. B.G.

N86-30615*# National Aeronautics and Space Administration, Washington, D.C.
VOLATILE COMPONENTS AND CONTINENTAL MATERIAL OF PLANETS
K. P. Florenskiy and O. V. Nikolayeva Aug. 1986 33 p Transl. into ENGLISH from Geokhimiya (Moscow, USSR), no. 9, 1984 p 1251-1267 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88478; NAS 1.15:88478) Avail: NTIS HC A03/MF A01 CSCL 03B

It is shown that the continental material of the terrestrial planets varies in composition from planet to planet according to the abundances and composition of true volatiles (H2O, CO2, etc.) in the outer shells of the planets. The formation of these shells occurs very early in a planet's evolution when the role of endogenous processes is indistinct and continental materials are subject to melting and vaporizing in the absence of an atmosphere. As a result, the chemical properties of continental materials are related not only to fractionation processes but also to meltability and volatility. For planets retaining a certain quantity of true volatile components, the chemical transformation of continental material is characterized by a close interaction between impact melting vaporization and endogeneous geological processes. Author

N86-30616*# National Aeronautics and Space Administration, Washington, D.C.
BILATERAL SYMMETRY OF CIRCULAR IMPACT STRUCTURES OF ASTROBLEMES
V. L. Masaytis and M. S. Mashchak Aug. 1986 16 p Transl. into ENGLISH from Meteoritika, (Leningrad, USSR), no. 41, 1982 p 150-156 Transl. by Scitran, Inc., Santa Barbar, Calif. Original document was prepared by All-Union Scientific Research Inst. of Geology, Leningrad, USSR
(Contract NASw-4004)

(NASA-TM-88480; NAS 1.15:88480) Avail: NTIS HC A02/MF A01 CSCL 03B

The relief of the true crater-bottom and the distribution of impactites and allogenic breccias for the Popigay and Kara astroblemes is examined. It is shown that the crater morphology and the distribution of ejecta of fragmented and melted masses has a series of features of symmetry in common with lunar analogs of large astroblemes, formed as a result of an oblique impact, as well as with impact and impact-explosive craters. This leads to the conclusion that both structures were formed as a result of oblique impact of meteoroid bodies; the trajectory projection of the body which formed the Popigay crater had an azimuth of 200 + or - 10 deg., while this azimuth for the Kara crater was 50 + or - 10 deg. Author

N86-30617*# National Aeronautics and Space Administration, Washington, D.C.

PRELIMINARY RESULTS OF DETERMINATION OF CHEMICAL ELEMENT CONCENTRATIONS IN THE AEROSOL OF VENUS CLOUDS

B. M. Andreychikov, L. M. Mukhin, B. N. Korchuganov, I. K. Akhmetshin, Ye. N. Tokarev, A. V. Medvedev, M. N. Goldfeld, V. M. Faynboym, A. V. Kalyuzhnyy, I. V. Petryanov et al May 1986 7 p Transl. into ENGLISH from Pisma v AZh (USSR), v. 12, no. 2, 1986 p 120-122 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASw-4005)

(NASA-TM-88423; NAS 1.15:88423) Avail: NTIS HC A02/MF A01 CSCL 03B

An X-ray radiometeric experiment is described along with the results of measurements of the elemental composition of aerosols in Venusian clouds. A preliminary analysis of the data showed that sulfur is present in the range of heights 63 to 47 km with mean content of 5.8 mg/cu m and that chlorine is present in the height range 61 t0 52 km with a mean content of 4.1 mg/cu m. The results of measurements in the range 52 to 47 km may come to an agreement if phosphorus is present in the aerosol with a mean concentration of 7.7 mg/cu m. Author

N86-30618*# National Aeronautics and Space Administration, Washington, D.C.

PRELIMINARY RESULTS OF MEASUREMENTS BY AUTOMATED PROBES VEGA 1 AND 2 OR PARTICLE CONCENTRATION IN CLOUDS OF VENUS AT HEIGHTS 47-63 KM

Yu. V. Zhulanov, L. M. Mukhin, and D. F. Nenarokov May 1986 13 p Transl. into ENGLISH from Pisma v AZh (USSR), v. 12, no. 2, 1986 p 123-130 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASw-4005)

(NASA-TM-88424; NAS 1.15:88424) Avail: NTIS HC A02/MF A01 CSCL 03B

Results of the preliminary processing of the Vega 1 and 2 descender data on the cloud layer structure of the Venusian atmosphere are discussed. A photoelectric counter for aerosol particles is described together with its optical and pneumatic circuits and operation algorithm. Vertical profiles of concentrations of particles with a diameter of 0.4 microns agree quantitatively with the Pioneer-Venus and Venera 9 and 10 data. Concentrations of these particles are: in the B layer, up to 190/cu cm; in the C layer, up to 10/cu cm; and in the D layer, up to 130/cu cm. Layers have sharp boundaries with a significant vertical heterogeneity of the aerosol concentration field inside them. Author

N86-30619*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

ANALYSIS OF JOVIAN DECAMTERIC DATA: STUDY OF RADIO EMISSION MECHANISMS Final Report, 15 Sep. 1982 - 31 May 1986

David H. Staelin, Philip W. Rosenkranz, Tomas A. Arias, Peter N. Garnavich, and Roel Hammerschlag 12 Aug. 1986 30 p

(Grant NAGw-373)

(NASA-CR-176878; NAS 1.26:176878) Avail: NTIS HC A03/MF A01 CSCL 03B

This research effort involved careful examination of Jovian radio emission data below 40 MHz, with emphasis on the informative observations of the Planetary Radio Astronomy experiment (PRA) on the Voyager 1 and 2 spacecraft. The work is divided into three sections, decametric arcs, decametric V bursts, and hectometric modulated spectral activity (MSA). Author

N86-30620*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FUGACITY AND CONCENTRATION GRADIENTS IN A GRAVITY FIELD

Charles E. May Jul. 1986 39 p

(NASA-TM-88809; E-3157; NAS 1.15:88809) Avail: NTIS HC A03/MF A01 CSCL 03B

Equations are reviewed which show that at equilibrium fugacity and concentration gradients can exist in gravitational fields. At equilibrium, the logarithm of the ratio of the fugacities of a species at two different locations in a gravitational field is proportional to the difference in the heights of the two locations and the molecular weight of the species. An analogous relation holds for the concentration ratios in a multicomponent system. The ratio is calculated for a variety of examples. The kinetics for the general process are derived, and the time required to approach equilibrium is calculated for several systems. The following special topics are discussed: ionic solutions, polymers, multiphase systems, hydrostatic pressure, osmotic pressure, and solubility gradients in a gravity field. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N86-30621*# Resource Management Associates, Inc., Lafayette, Calif.

PRELIMINARY DEVELOPMENT OF A GLOBAL 3-D MAGNETOHYDRODYNAMIC COMPUTATIONAL MODEL FOR SOLAR WIND-COMETARY AND PLANETARY INTERACTIONS

Stephen S. Stahara May 1986 20 p

(Contract NASw-4011)

(NASA-CR-177090; NAS 1.26:177090; RMA-TR-101) Avail: NTIS HC A02/MF A01 CSCL 03B

This is the final summary report by Resource Management Associates, Inc., of the first year's work under Contract No. NASW-4011 to the National Aeronautics and Space Administration. The work under this initial phase of the contract relates to the preliminary development of a global, 3-D magnetohydrodynamic computational model to quantitatively describe the detailed continuum field and plasma interaction process of the solar wind with cometary and planetary bodies throughout the solar system. The work extends a highly-successful, observationally-verified computational model previously developed by the author, and is appropriate for the global determination of supersonic, super-Alfvenic solar wind flows past planetary obstacles. This report provides a concise description of the problems studied, a summary of all the important research results, and copies of the publications. Author

N86-30622# Lawrence Livermore National Lab., Calif.

RADIATING SHOCKS AND CONDENSATIONS IN FLARES

G. H. Fisher 1985 12 p Presented at the NSO/SMM Summer Workshop, Sacramento, Calif., 1 Aug. 1985

(Contract W-7405-eng-48)

(DE86-005620; UCRL-93858; CONF-8508157-1) Avail: NTIS HC A02/MF A01

Rapid energy release (by either thick target (beam) or thermal models of heating) in solar flare loop models usually leads to chromospheric evaporation, the process of heating cool chromospheric material to coronal temperatures, and the resulting increase in hot soft x-ray emitting plasma. The evaporated plasma flows up into the coronal portion of the loop because of the increased

pressure in the evaporated region. However, the pressure increase also leads to a number of interesting phenomena in the flare chromosphere. The sudden pressure increase in the evaporated plasma initiates a downward moving chromospheric condensation, an overdense region which gradually decelerates as it accretes material and propagates into the gravitationally stratified chromosphere. Solutions to an equation of motion for this condensation shows that its motion decays after about one minute of propagation into the chromosphere. When the front of this downflowing region is supersonic relative to the atmosphere ahead of it, a radiating shock will form. If the downflow is rapid enough, the shock strength should be sufficient to excite UV radiation normally associated with the transition region, and furthermore, the radiating shock will be brighter than the transition region. These results lead to a number of observationally testable relationships between the optical and ultraviolet spectra from the condensation and radiating shock. DOE

N86-30623# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
CHARGE STATES OF ENERGETIC SOLAR PARTICLES [DIE LADUNGSZUSTAENDE SOLARER ENERGETISCHER TEILCHEN]
Achim M. Luhn Feb. 1986 141 p In GERMAN
(MPE-195; ISSN-0178-0719; ESA-86-95407) Avail: NTIS HC A07/MF A01

Ion charges of energetic solar particles were measured and interpreted in order to study their origin, and to understand processes which lead to the heating and acceleration of ions and which play a role in their transport to the earth. Measurements on ions of C, N, O, Ne, Mg, Si, S, and Fe were performed with the ULEZEQ sensor on the ISEE-3 satellite; energy, charge number, and ion charge were separately and independently determined. In order to investigate the influence of nonequilibrium processes on the formation of ion charges, the effect of a suprathermal tail in the electron distribution as well as a time-dependent ionization in the source region plasma were studied; however, the measurements on N, Si, and S could not be explained. During He3-rich periods the average charges of Si and Fe are significantly higher than in a normal solar flare. This is not the case during He(+)-rich events. ESA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N86-30624*# Wisconsin Univ., Madison. Dept. of Physics.
COSMIC X-RAY PHYSICS Semiannual Status Report, 1 Jan. - 30 Jun. 1986
D. McCammon, D. P. Cox, W. L. Kraushaar, and W. T. Sanders Jul. 1986 16 p
(Grant NAG5-629)
(NASA-CR-177227; NAS 1.26:177227) Avail: NTIS HC A02/MF A01 CSCL 03B

The analysis of the beryllium-filtered data from Flight 17.020 was completed. The data base provided by the Wisconsin diffuse X-ray sky survey is being analyzed by correlating the B and C band emission with individual velocity components of neutral hydrogen. Work on a solid state detector to be used in high resolution spectroscopy of diffuse or extend X-ray sources is continuing. A series of 21 cm observations was completed. A paper on the effects of process parameter variation on the reflectivity of sputter-deposited tungsten-carvon multilayers was published. B.G.

N86-30625*# Smithsonian Astrophysical Observatory, Cambridge Mass.
A STUDY OF (OI) 63.2 AND 145.5 MICRON EMISSION FROM M17 AND SGR A FROM THE LEAR JET Final Report, 1 Oct. 1982 - 31 Mar. 1986
Gary G. Melnick Mar. 1986 27 p
(Grant NAG2-188)
(NASA-CR-177015; NAS 1.26:177015) Avail: NTIS HC A03/MF A01 CSCL 03B

The Lear Jet Observatory was used to observe the 157.7 micron (C II) line from the galactic H II regions W3 and W51. These measurements established a lower limit in the 157.7 micron line for solar luminosity of 360 from W3, assuming adistance of 2 kpc, and a solar luminosity of 4100 from W51, assuming a distance of 7 kpc. The data indicated that the CII/far infrared continuum ratio for both W3 and W51 were within the range found for other galactic H II regions. B.G.

N86-30626# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NONLINEAR TEMPORAL MODULATION OF PULSAR RADIO-EMISSION
A. C.-L. Chian 1984 17 p
(DE86-700670; INPE-3272) Avail: NTIS (US Sales Only) HC A02/MF A01

A nonlinear theory is discussed for self-modulation of pulsar radio pulses. A nonlinear Schroedinger equation is derived for strong electromagnetic waves propagating in an electron-positron plasma. The nonlinearities arising from wave intensity induced relativistic particle mass variation may excite the modulational instability of circularly and linearly polarized pulsar radiation. The resulting wave envelopes can take the form of periodic wave trains or solitons. These nonlinear stationary wave forms may account for the formation of pulsar microstructures. DOE

99 GENERAL

No abstracts in this category.